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USSR Report

MILITARY AFFAIRS

AVIATION AND COSMONAUTICS

No 9, SEPTEMBER 1986

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Except where indicated otherwise in the table of contents the following is a complete translation of the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow.

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IMPROVING TRAINING AND INDOCTRINATION AT AIR FORCE SCHOOLS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 1-3

[Article by Hero of the Soviet Union Honored Military Pilot USSR Col Gen Avn Grigoriy Ustinovich Dolnikov, deputy commander in chief of the Air Forces for military educational institutions: "Improving Quality of the Training and Indoctrination Process"]

[Text] Military educational institutions, which train highly-qualified cadres, play an important role in accomplishing the tasks of strengthening our country's defense capability and increasing the combat readiness of the USSR Armed Forces. Experience convincingly attests to the fact that a soldier who is totally devoted to the Communist Party and the homeland, who is knowledgeable, a thinking individual, with a consummate mastery of his combat equipment and weapons, is a decisive force in war.

Each year our military aviation schools supply Air Force units and subunits with well-trained specialists in various areas of specialization. Graduates of the Borisoglebsk, Tambov, Syzran, and Chernigov higher military aviation schools for pilots, of the Kharkov and Riga engineering schools, the Vasilkov Military Aviation Technical School, and other military educational institutions enjoy a deserved reputation in the line units. They are distinguished by excellent job proficiency, a high degree of ideological conviction, and dedication to their career choice. This indicates that the administrators and faculty at the above-named military educational institutions have a correct understanding of their tasks and are focusing all efforts on training worthy replacements and on all-out improvement in the quality of the training and indoctrination process.

In recent years a great many good things have been accomplished at Air Force higher educational institutions in the area of methodology and military education science. We should not rest on our laurels, however. That with which we were yesterday satisfaied to a certain degree proves to be unsatisfactory today. Practical realities as well as scientific and technological advance are placing more and more new and more stringent demands on the moral-political and job-related training of officer cadres and, consequently, on the activities of military educational institutions.

The party displays a great deal of concern with training highly-skilled specialist personnel for all domains of the economy. The draft Basic Directions of Restructuring of Higher and Secondary Specialized Education have been presented for nationwide discussion. This document clearly expresses the idea that higher education is assuming increasing significance in improving societal relations, in affirming the socialist way of life, and in activating the human factor. It is important to enrich the ideological-theoretical, humanities content of higher education and to strengthen its link with practical societal activities -- the foundation for forming excellent civic and moral qualities in our citizens. We must more fully utilize the considerable potential of educational institutions in the area of improving communist indoctrination of youth. The party views the higher educational institution as an important part of its cadre policy. The party has formulated the task of ensuring priority development of higher and secondary education in relation to technical upgrading of the nation's economy.

All these demands, with a certain adjustment to the specifics of the military, directly apply to Air Force higher educational institutions. A most important task today is to accomplish a substantial improvement in the level of training and indoctrination work and to give it a new, qualitative thrust forward. This task is already being accomplished at military aviation schools for flight personnel. A particularly large job must be accomplished at the Yeysk Higher Military Aviation School for Pilots. Administration, faculty, and flight instructor personnel must become profoundly aware of the full importance of this problem and restructure their operations in conformity with the demands of the 27th CPSU Congress and the June (1986) CPSU Central Committee Plenum.

As we know, one of the principal indicators of the job proficiency of young aviators is the air time they log during training. At the same time we should note that the number of hours logged by pilot cadets should be directly proportional to the quality of their skills and abilities, that is, after completing flight training a young pilot should possess confident mastery of his aircraft to the specified degree. The efforts of flight instructor personnel should be directed precisely toward quality of flying proficiency.

A decline in effectiveness of training has recently been noted at certain flight schools. What is the problem? Analysis indicates that the causes lie primarily in the fact that the administration and political agencies of these military educational institutions have slackened off in their demandingness pertaining to such work as seeking genuinely existing reserve potential, efficient utilization of available aircraft and optimal work-loading of airspace, as well as improvement in administration, management and control of flight operations. Less attention is being focused on improving the flight training process. A purposeful search for possible ways and means of accomplishing a quantitative increase in flight hours logged and improving quality of flight hours is being poorly conducted, although this is one of a school's most important investigative tasks.

Flight training is a special and the most complex type of professional training. It involves comprehensive consideration of the individual characteristics of young men and their thorough preparation from a

theoretical, practical, and moral-psychological standpoint. Here too one cannot overstate the role of the instructor pilot. And yet in some schools insufficient attention is devoted to training of instructor personnel. Instances are noted, for example, where pilots' high proficiency rating is not reinforced with improvement in their professional skills. For this reason flaws in teaching methods used with student pilots and in determining their readiness to solo in general and for specific maneuver sequences in particular are not surprising.

Increasing the methodological skills of flight instructor personnel and deepening their knowledge of military education science and psychology is one of the most important items, which should always be the focus of attention on the part of methods councils and party organizations at military educational institutions.

Unquestionably improvement in the training and indoctrination process requires a display of initiative, innovation, and businesslike efficiency on the part of commanders and political workers, faculty members and instructor pilots. Every effort must be made to give support to persons who are capable, searching, and seeking to make their contribution toward improving the quality of training of specialist personnel. Squadron commander Lt Col A. Andreyev and Sr Lts S. Kolchin and A. Bezhin devote all their energies, experience and knowledge to educating future air warriors. These officers have earned the right to be called socialist competition right-flankers in the year of the 27th CPSU Congress. Others seek to emulate them. We have no patience, however, with those who are unable or unwilling to keep pace with the times. There is no place at military educational institutions for such instructors.

Analysis of the teaching and learning process at military educational institutions also compels one to consider the problem of time. Today, in connection with the increasing complexity of combat equipment and weapons, there is an increasing conflict between the steadily growing volume of knowledge and skills required by cadets and the total time available for their training. The shortage of time which arises requires that we seek ways to resolve this problem. One way is seen in further intensification of the training and indoctrination process and in its more precise organization. For this we must more efficiently utilize advances in military science and advanced know-how, we must improve planning, increase discipline and organization, and change the style and methods of management of the learning process.

Scientifically-substantiated planning involves efficient utilization of time, correct placement of manpower and resources, goal-directed activity by commanders and teaching faculty, and smoothness of operation by the entire collective. It enables one to direct the efforts of the teaching faculty in a prompt and timely manner toward complete, high-quality accomplishment of the training curriculum.

A present task is to ensure that higher educational institutions definitely see that their students maintain a high level of knowledge throughout their entire practical activities. The role of management of the learning process and the system of verification of target accomplishment becomes more obvious

in light of this demand. As we know, checking and verifying learning progress aims at thorough synthesis, dissemination, and practical adoption of affirmative experience, advanced techniques and methods of teaching and indoctrinating cadets. Unfortunately in some schools checking and verification of the learning process boils down to taking note of facts, while this work should be truly of the nature of scientific research.

This happens most frequently because creative initiative and independence have become a rarity at service schools. Administrative personnel and faculty expect instructions from a higher echelon on every matter. Relying totally on others is a harmful phenomenon. No longer will there be detailed instructions from higher up the chain of command. As was noted at the June (1986) CPSU Central Committee Plenum by CPSU Central Committee General Secretary Comrade Mikhail Sergeyevich Gorbachev, directives, even the finest directives, should not take the place of innovativeness on the part of the masses. Restructuring presumes all-out development of initiative and independence on the part of workforces and by all cadres. In present-day conditions it is out of the question to determine all matters centrally, and it is also virtually impossible. This means that one must learn to make specific, job-related decisions locally, taking into consideration both objective and subjective conditions.

A scientific approach to planning the learning process and organizing efficient monitoring and verification is only one aspect of the problem under discussion. Another aspect involves high quality of training activities. How can it be achieved? "A paramount task," state the Basic Directions, "is to make a decisive shift from mass-scale instruction to intensification of the individual approach and development of the creative abilities of the future specialists. All efforts to step up student learning activities must be grounded on all-out development of competitiveness in mastering knowledge."

This is a correct statement, but it applies not only to students but to faculty as well. It is important to develop in cadets a continuous interest in the subjects they are studying, and consequently there must be a desire to learn. Quite frankly, this is far from easy to accomplish. Considerable creative effort is required of the instructor, the ability to pique people's interest and to awaken in them the desire to obtain additional knowledge in a given field.

One of the most promising teaching methods is the problems approach, which stimulates students' thinking. A certain amount of attention is devoted to it at military educational institutions. The most widespread method employed in the problems approach to learning is so-called problem presentation at lectures covering course material. The task of the problems approach in learning is to develop the cadet's creative potential, scientific thought, and scientific research ability. Thus the lecture serves as a means of intellectual interaction between instructors and students. This is particularly important for the graduates of engineering schools, because scientific and technological advance requires profound, thorough knowledge. As is noted in the Basic Directions of Restructuring Higher and Secondary Specialized Education, the task is to develop cadres capable of accomplishing revolutionary transformations in equipment, technology and organization of

production, and a vast increase in labor productivity. Training of broad-specialization personnel should provide for deepening the theoretical foundation and mastering the fundamentals of engineering and management activity. The process of forming and shaping engineer cadres should be subordinated to developing in engineers the skills and habits of independent technical innovation, systems analysis of technical and economic problems, and the ability to find effective solutions. Professor and Doctor of Technical Sciences Col A. Tarasenkov (Military Air Engineering Academy imeni N. Ye. Zhukovskiy), Candidate of Technical Sciences Col L. Pyatykhin (Kharkov Higher Military Aviation Engineering School), Col S. Petrov (Perm Military Aviation Technical School), Professor and Doctor of Technical Sciences Col N. Sivov (Kiev Higher Military Aviation Engineering School), and many others are deservedly respected by students and cadets.

New and improved combat equipment and weapons strongly demand the adoption of a sequence in training specialist personnel whereby acquired knowledge of theory will be supplemented without delay with the development of practical skills and their utilization. While at pilot and navigator schools cadets implement their knowledge in practical flying, at engineering and technical schools knowledge is applied in maintaining and servicing equipment at training airfields, in laboratories and on specialized simulators. The latter require constant improvement. Inestimable assistance here will be given by military scientific societies as well as technical innovation, invention and efficiency innovation groups.

Important reserve potential for active learning is to be found in development of independent work by students. At first glance this would seem to be in a satisfactory state at Air Force higher educational institutions. Independent study, consultations and interviews are held on a regular basis. Frequently, however, cadets are left to their own devices during these scheduled times. It is quite obvious that many young people are unable to work independently with the literature and primary sources. This means that such an individual must be taught first of all correct organization of work regimen and to use various sources of information and technical means, and assistance must be constantly given in this matter. Thus independent study should be a monitored and controllable process.

Our military educational institutions possess well-equipped lecture halls, laboratories, and training classrooms. In the process of scheduled class activities their equipment is actively utilized in training, and yet during independent study cadets frequently do not have access to specialized training classrooms. This is due to the fact that this is the way some schools seek to safeguard equipment and extend its service life. In actual fact, however, sometimes other interests are being pursued: to be able to impress a visiting inspection team with the facilities. Quite frankly, there is little value to such "museum" lecture halls and training classrooms, which students enter like on a special outing or field trip. One should not forget that modern technical teaching devices, even the most costly ones, are nothing but tools for acquiring knowledge and skills, which are needed in order to work with no less modern and costly hardware in the line units.

Recently considerable experience has been amassed at many Air Force schools in applying active learning methods with the aid of various technical devices. Automated teaching systems based on electronic computers are being more extensively used. They are helping to make more efficient the labor both of faculty and students.

Organization of the training and indoctrination process, with training time in short supply, requires particular precision and flexibility, which would provide maximum return on each minute of class or drill. This can be achieved first and foremost by boosting the methodological level in teaching subjects, by high-quality preparation of class instructors, and by maximal coverage of students.

As experience indicates, organization in training depends to a significant degree on the demandingness of commanders and instructors and their ability to rely in their work on NCOs, party and Komsomol organizations. A high degree of demandingness develops in students a sense of responsiblity for the assigned task, for precise and faultless performance of job duties, execution of orders and instructions by superiors.

A principle which is becoming increasingly more important today is the principle of teaching students what is needed in war. It contains a practical directional thrust to study. Unfortunately in recent years interest in the priceless experience of the Great Patriotic War has unwarrantedly declined at military educational institutions. And yet this experience teaches us that today as well the road to victory lies through persistent, daily military labor, multiplied by maximum exertion of moral and physical energies. This means that this principle presumes not only learning combat skill but also forming in students excellent moral-political, psychological and physical qualities. Consequently it is necessary to give consideration to ensuring that appropriate training activities are conducted against a tactical background which maximally approximates actual combat operations in a complex, intense environment, which requires of the students resourcefulness, courage and persistence, physical stamina, psychological control, and fast reaction, which ensure victory in today's highly-dynamic, intense combat. During their years of training, service school students should receive solid ideological-moral conditioning and comprehensive specialized training.

Success in training and indoctrinating future officers is guaranteed by an individual approach and a healthy microclimate in the collective. Correct interrelationships among cadets, with commanders and instructors are formed precisely in the subunits with firm military discipline. Young men should become clearly convinced that strict observance of regulations, honesty, and the ability to conduct oneself in a worthy manner are conditions which will help them in the future, when they take over command of subunits and are building strong, combat-efficient military collectives.

We should also state that concern with subordinates consists not only in meeting their material needs, as some people think, but chiefly in increasing their military skills and in forming highly-moral and ethical individuals with an activist experiential posture. In this connection I should like to stress that each specialist is first and foremost a person, an individual with his

strong points and shortcomings. Consequently training of highly-skilled cadres should be viewed through the prism of ideological-political, labor and moral indoctrination. For this it is necessary substantially to boost the ideological-theoretical and methodological level of teaching the social sciences as a solid foundation for forming and shaping a materialist philosophical outlook on the part of Air Force specialist personnel. It is important to eliminate rote lecturing and dogmatism as well as dull theorizing in teaching the social sciences. It is necessary more rigorously to take into consideration the school's area of specialization and the nature of the future activities of its graduates. Social scientists, working together with instructors in the other departments, should raise the ideological directional thrust of the entire teaching and indoctrination process, develop in the future officers skills in innovative application of dialectic method in their job-related and community-oriented activities, and teach political alertness and an uncompromising attitude toward hostile ideology.

I should also like to note the importance of comprehensive physical development of students and cadets. This is an important component part in training today's military man. Particular attention must be focused on physical training of flight personnel. Today's combat involves heavy physical and emotional stress. Victory will be won by he who, in addition to a high degree of flying skill, has superior physical conditioning.

A new academic year has begun at military educational institutions. It has been preceded by considerable preparatory work. The causes of deficiencies have been studied, and specific measures have been taken to correct them. But this is only half the job. Everything new and progressive, which makes it possible to improve the effectiveness and quality of teaching, must be adopted and skillfully applied in daily, practical instructional activities.

Success in work and the end results of labor in the new year will depend chiefly on the organizational activity of commanders and political agencies pertaining to mobilizing military personnel for prompt implementation of the decisions of the 27th CPSU Congress and high-quality accomplishment of combat and political training tragets. Implementing the party's decisions and instructions, commanders, political workers, and faculty members should do everything to ensure that students become not only competent specialist personnel but also ideologically-conditioned party warriors and reliable defenders of the socialist homeland.

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GREATER COMBAT TRAINING REALISM, EFFORT URGED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 4-5

[Article, published under the heading "Be Alert, In a Continuous State of Combat Readiness," by Mar Avn G. Skorikov: "Learn That Which Will be Required in Combat"]

[Text] One of the most important criteria which determine the level of combat readiness and fighting efficiency of Air Force units and subunits is their combat proficiency and the degree to which the level of training proficiency is in conformity with the character and demands of conduct of warfare today. In conditions where the aggressive forces of imperialist nations, particularly the United States, are nurturing plans to apply the pressure of force against the USSR and the nations of the socialist community, continuous vigilance and a high degree of troop combat readiness constitute a reliable guarantee of peace and security of peoples. The party and people are constantly concerned with strengthening our country's defense capability and increasing the might of its Armed Forces, including military aviation.

Scientific and technological advances are exerting decisive influence on furnishing troops with new equipment and weapons, and consequently on the forms and modes of warfare, which in turn place greater demands on training personnel. The experience of the Great Patriotic War clearly confirms the importance of combat proficiency on the part of troops and war-fighting capability by the Armed Forces as a whole. The lessons of the war serve as a warning against any and all overestimation of the level of proficiency of troops and attempts to avoid solving the vital problems of combat training of units and subunits.

In modern-day conditions the principle of teaching troops that which will be required in combat signifies the need to structure the entire system of training personnel taking into account the character of present-day combat operations. In other words, training of troops should be first and foremost practical and specific. Unit and subunit leader personnel should acquire solid skills in thorough organization for combat operations on a tight timetable and in any conditions, should bring operational and combat training of troops as close as possible to the conditions of modern war, should increase demandingness, resolutely seek to overcome excessive attention to

form with consequent detriment to content, unnecessary relaxation of demands, excessive situation simplification, and should make the training environment as complex as possible.

The experience of the Great Patriotic War, alongside modern forms and methods of training, is of enduring significance in training flight personnel. We should state that fliers continued persistently studying and learning even at the battlefront. The briefest respite in combat operations was used for theoretical and practical training. Commanders of air combined units and units devoted particular attention to young flight personnel. Army Gen S. Krasovskiy, for example, commander of the 2nd Air Army, ordered that veteran combat airmen be assigned to the younger men, to teach the newcomers by the method of combat mentorship skillfully to master their aircraft, tactics, and weapons. Tactical air conferences, seminars, and brief drills to accomplish exchange of experience and know-how were conducted on an extensive basis in the air army. New tactics of air-to-air combat and air-to-ground strikes were aggressively developed and practically adopted by the units and subunits.

In order to increase the accuracy and effectiveness of bombing strikes, for example, bomber corps commander I. Polbin was the first to master bombing from a steep-angle dive, right up to near-vertical. Learning, however, that some pilots were not happy with diving at steep angles with the Pe-2 due to the extreme G loads on pullout, he personally organized demonstration flights and demonstrated the aircraft's capabilities to the pilots. The commanding officer's personal example had its effect. Aircrews began working more actively on mastering dive bombing.

A search for new tactics was constantly in progress in the units of the corps. The tactic of dive bombing from a continuous orbit was devised, for example. This technique was subsequently dubbed "Polbinskaya Vertushka" [Polbin's Revolving Door]. Ivan Semenovich did a great deal to train marksman-accuracy aircrews and squadrons. Every regiment in the corps contained such subunits. These measures resulted in increasing the effectiveness of bombing strikes, particularly against point targets.

On 18 July 1944, for example, a marksman-crew force of the 162nd Guards Bomber Regiment, consisting of 17 Pe-2s, delivered a strike near Krotoshino and Zhuravka (south of Lvov) on an enemy tank and troop concentration. Gen I. Polbin noted with satisfaction that only two of all the bombs dropped by the force exploded off the target. About 10 tanks and more than 20 armored carriers were destroyed or disabled.

We could cite many similar examples of skilled actions by airmen. Most of them became possible because the air warriors were constantly looking for new tactics to use against the enemy, which in turn helped improve overall tactics. This principle remains valid today.

Practical experience has demonstrated that increase in the intensity and effectiveness of combat training depends in large measure on the level of training and preparation on the part of the organizers and leaders of combat training. In order to be up to today's demands, a commander at any level should possess first and foremost communist conviction, a high degree of

integrity and conscientiousness, and should possess a consummate mastery of his equipment. Commander maturity is formed precisely on this foundation.

Tactical air exercises play an important role in the development of qualities essential to commanders for command and control of their subunits. Such exercises make it possible for commanders and staff officers to develop the ability thoroughly to analyze the environment and situation in which their troops are operating, to figure out the "aggressor's" tactical intentions, and to determine appropriate countermeasures.

The complex environment generated at a tactical air exercise thoroughly and severely tests the ability of commanders to lead their men. This is why it should always maximally approximate actual combat, without unnecessary instances of situation simplification and undesirable compromise with realism.

The instructiveness of exercises and the anticipated result depend entirely on the quality of preparation of the organizational-methods material, which should be prepared by competent persons, headed by the commanding officer and exercise director. In order to teach personnel to perform with initiative and originality in a tactical air exercise, it is necessary to use in an integrated manner weapon and tactical ranges and to set up the target environment taking into account new weapons and combat equipment in the possession of the potential adversary and modes of their employment, and extensively to utilize performance monitoring and recording devices.

Thorough preparation by leader personnel, umpires, trainees, as well as the site of the exercise helps achieve maximum effectiveness of a tactical air exercise. It is for good reason that the USSR Minister of Defense demands greater responsibility on the part of exercise directors for preparing for and conducting exercises and that skillful measures be taken to increase the complexity of the exercise environment and situation, making it maximally approach an actual combat environment.

In order to achieve these results, it is essential constantly to improve organizing activity methods employed by Air Force commanders and staff officers in conditions of extremely stringent time availability. As we know, this work is grounded on thorough planning and careful scheduling. A precise commander's plan and exercise scenario in turn serve as a foundation for intelligent planning and scheduling. To accomplish this it is very important to have a thorough understanding of the objective of the exercise, to understand the role of one's subunit or unit in the mock combat, and to refine and detail matters pertaining to teamwork and coordination, manner and sequence of accomplishing intermediate missions.

After being completely briefed, the commander estimates the situation and at the same time draws up his concept of operations. This involves the participation of his deputies, chiefs of sections and services. The commander's concept gradually takes form as a result of creative exchange of opinions and evaluation of different variations of action. After the commander's concept has been communicated to subordinates, all leader personnel swing into action. The headquarters staff organizes preparation of suggestions pertaining to determining and drawing up operational instructions,

which are to be ready by the designated time. Thus the entire process should be performed in strict sequence and in parallel in all services.

As a principal command and control agency, the headquarters staff provides the commander with continuity in controlling subunits, plans combat operations, and organizes coordination and operations support. The headquarters staff should always be kept up to date on all activites and should promptly prepare and communicate suggestions and proposals to the commanding officer. The main thing is organization of execution of the commander's decisions taking into account the development of events.

Tactics is a most important component of skill and proficiency, essential for victory in today's combat. In military aviation air-to-air combat, air-to-ground combat, and other forms of combat operations on a tactical scale are carried out in the course of combat flying. Consequently theory and practice of combat flying are the domain of study of tactics. The process of mastering the theoretical points of organization for and conduct of combat operations by aviation subunits and units comprises the nucleus of tactical air training, in the process of which development of a closely-knit fighting team takes place within aircrews, two-aircraft elements, flights, detachments, and squadrons, as well as forces of various tactical designation, and coordination is developed between them, as well as with subunits of other air components and combat arms. In the process of such training, a pilot takes form and shape as an air warrior, while the subunit and unit become a smoothly-functioning fighting outfit capable of successfully accomplishing assigned missions.

It is not surprising that all-out improvement of tactical air training occupies the center of attention of Air Force commanders and staffs. Standards and methods documents are constantly being revised and developed, and flight personnel are mastering more efficient techniques and modes of combat operations in instrument weather, day and night, at various altitudes. On the whole this is producing positive results. At the same time the USSR Minister of Defense is calling for improved quality of pilot tactical training and is demanding the eradication of predictable pattern and unnecessary situation simplification.

Due to deficiencies in combat training methodology and practices, for example, one still encounters instances of excessively close supervision and regulation of commander activities, infringement of their initiative, and an absence of competitiveness and incentives to seek new forms and methods of increasing air proficiency. This sometimes engenders unoriginal solutions and standard aircrew actions at tactical air exercises as well as a tendency toward excessive simplification of the training environment in working on difficult items. Trainees sometimes find themselves in conditions which do not require initiative, resourcefulness, or independence. This is also promoted by excessively detailed briefings on the opposing force at two-sided field exercises, as well as deficiencies in organizing inspection and grading of pilot tactical training. These must be vigorously combated.

Today aviation units are equipped with excellent aircraft, capable of accomplishing any and all missions in modern combat. But this should not make us complacent. We shoud not forget that complex equipment is operated by

people, on whom success depends to a decisive degree. In connection with this one of the important tasks for commanders at all levels is to ensure that their men do a quality job of mastering their aircraft and aircraft armament, utilize them skillfully, and expertly exploit their capabilities.

In the aviation regiment in which officer V. Stukanskikh serves, for example, they have developed a well-structured system of training pilots in conditions maximally approximating actual combat. It is based on precise planning and scheduling of training sorties and drills on the ground, taking into account each individual's level of proficiency. Meticulous work with each individual combat pilot both before and after a training sortie comprises the foundation of the process of airman training and indoctrination. On preliminary preparation days, pilots mandatorily practice scheduled maneuvers on flight simulators, which provide capability effectively to simulate an actual flight environment. In this regiment special attention is devoted to preparing for training sorties at night and in adverse weather.

An intelligent approach to things and intensification of the process of training and indoctrination enable Air Force personnel to economize in tach time on combat aircraft, aviation fuel, and precious training time.

Officer G. Melnichuk's men achieve excellent, stable performance results, and this is not surprising, for leader personnel approach accomplishing assigned tasks in an innovative manner and are constantly seeking progressive, advanced ways to accomplish them.

The methods council is particularly respected in this unit. Flying methods conferences and meetings are held at its initiative on a regular basis, at which matters pertaining to job-specific training of aviation personnel are discussed, advanced know-how is studied, mistakes and errors in flight operations are analyzed, and recommendations are drawn up for correcting them. Matters pertaining to the professional development of flight personnel are always given primary emphasis.

Matters pertaining to improving pilot tactical training require constant study and broad dissemination. Publicity first and foremost ensures dissemination of advanced know-how. In the course of combat training it is necessary to take careful note of new phenomena both in methods and in tactics, to synthesize experience and more rapidly disseminate it in other units. It is important to make a more determined departure from training flight personnel in hothouse conditions and to increase the percentage share of training sorties flown from field airstrips, in unfamiliar areas and on unfamiliar ranges. This will ensure to a substantial degree implementation of the principle of teaching troops that which is essential in war.

MSU G. K. Zhukov wrote: "I was convinced by many years of practical experience that only tactically-knowledgeable commanders can do a good job of training a combat unit in peacetime and of gaining victory in war with the least casualties." Combat training experience attests to the fact that optimal results at field exercises are achieved by those subunits and units the commanders and personnel of which perform boldly and with determination, taking the actual situation into consideration and maximally utilizing the

capabilities of their equipment and weapons. In short, they act in a tactically knowledgeable and aggressive manner. Air Force commanders of this type include Hero of the Soviet Union Lt Col V. Ochirov, Col A. Tsalko, holder of the Order of the Red Banner, and Lt Col A. Rutskiy. They are a worthy example for all personnel of the Air Forces which, together with the other branches of the USSR Armed Forces, are guarding the sacred borders of the socialist homeland.

3024
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AIRFIELD ATTACKED BY "AGGRESSOR" FORCE

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) p 6

[Article, published under the heading "Be Alert, In a Continuous State of Combat Readiness," by Military Pilot 1st Class Maj I. Petrakov: "'Combat' at an Airfield (Report From a Special Tactical Exercise)"]

[Text] It was early morning. A light mist clung to the forest which was closely flanking the airfield. The sentry who was guarding the ramp area of the alert-duty flight listened intently to the morning stillness and peered at the whitish mist in the distance as he strode along the perimeter fence, endeavoring to follow the Manual of Garrison and Guard Duties to the letter. All seemed quiet.

But what was this? It was dead calm, but some bushes suddenly stirred, as if somebody had accidentally brushed against them. Pfc N. Davydov immediately reported his suspicions to the commander of the alert-duty flight, Military Pilot 1st Class Maj A. Burovtsev. The latter decided to beef up airfield security and informed the command post. At his command the men quickly proceeded to advance-prepared positions.

Within a few minutes it became clear that the commander had acted correctly. From the woods they heard short bursts of assault-rifle fire by a "raiding party," to which the airmen responded with brisk, coordinated fire. The raiding party's attempt to hit the alert-duty flight with the element of surprise and disable the aircraft failed.

This is the way a special tactical exercise on airfield security and defense began. Informed of the attack on the alert-duty flight, the senior officer phoned the guardhouse and ordered reinforcements sent out to the ramp prior to arrival of the main body of security forces.

In the meantime the "aggressor" was pressing hard. The chatter of bursts of assault-rifle fire could be heard from various parts of the field, and the ringing echo of mortar shell and grenade bursts reverberated over the airfield. Soon an infantry fighting vehicle appeared on a taxiway, with the vehicle crew placing aimed machinegun and assault-rifle fire on the

"aggressor." A mobile security alert team, led by security company commander V. Stolyar, had arrived.

The airmen engaged the enemy without delay, and the fighting quickly began drifting toward the woods. It was obvious that the "aggressor" was carrying out a ploy, trying to draw the defending forces into pursuit, to entice them out of their fortified positions in order to pincer and destroy them. But the soldiers were not fooled by this ruse.

A siren signalled reassembly. Beefing up installation security with additional crews, Capt V. Stolyar headed with his men toward the runway, where a party of defenders led by the security company's deputy commander for political affairs, Sr Lt V. Dyachenko, was engaged in unequal combat with an assault force.

While the men of the security company fought off the attack, aviation unit personnel hastily took up positions in designated defensive sectors and stepped up patrol activities. A noose of encirclement began to draw tight around the assaulting force.

The "aggressor" engaged his reserves in order to avert the threat of annihilation. Armored personnel carriers proceeded to advance on the airfield from the forest, providing the withdrawing assault force with covering machinegun and assault-rifle fire.

According to the plan of the Air Force unit's commander, at this moment an element of eight fighter-bombers was supposed to take off and hit the "aggresor's" reserves. But the weather had its own plans: the airfield was now solidly socked in by fog, which was acting as an ally to the "raiding force." An alternate plan had to be found.

Following a brief conference at the command post, the commander decided to reinforce the troops defending the flight line. The main thing was to drive the "aggressor" back away from the aircraft and prevent them from being damaged or destroyed. Skillfully utilizing terrain cover and constantly moving, Jr Sgts A. Nagoy, N. Shurenko, and V. Dorovskiy, and Pvts L. Turkin, V. Kurashkin, and G. Bakirov, delivering close-range concentrated fire, forced the "aggressor" to abandon positions and withdraw into the forest. One sensed that officers V. Stolyar and V. Dyachenko had trained their men well in ground combat.

The fighting slackened somewhat, and soon the firing ceased. The technicians and mechanics proceeded to inspect and ready the aircraft to fly. But was the "aggressor" gone for good, or would he undertake another attempt to reach his objective? These questions were still open.

The ramp areas were alerted to be prepared for any scenario instructions. It soon became clear that the warning was not without grounds. Signal flares were fired skyward at various points around the airfield, informing the airmen that the opposing force had employed weapons of mass destruction. Things had taken a serious turn.

At the command post an analysis team headed by Maj K. Matviyenko proceeded to appraise the situation and make an analysis of possible casualties and combat equipment losses. Maj V. Ornadskiy, the unit's chemical service chief, quickly determined the boundaries of the contaminated area, Sr Lt A. Katrichenko, in charge of the officer reconnaissance patrol, conducted a general reconnaissance of the airfield and determined the nature of the inflicted "damage," while Lt Col V. Kartashev, who headed the aircraft preliminary inspection team, determined the number of "damaged" aircraft and specified a timetable for their return to service.

Wearing protective suits and masks, the airmen went to work, with a volume of work which had increased greatly. Closely observing the performance of his men from the command post, the unit commanding officer took incoming reports and made decisions on the spot. This officer realized that with an increase in the work volume of repair and preventive maintenance activities, it was necessary to organize his men's labor so that everything was done rapidly and without delay. The time performance standards were quite tough. How could they be surpassed? Thoroughly evaluating the situation, the commander decided to form a composite subunit to neutralize the consequences of the "nuclear" strike.

Such a team was gathered together literally in minutes. The airmen proceeded with rescue and recovery tasks. The fire crews led by Sr Lt A. Davydov and WO V. Zabegayev proceeded to fight a fire which was raging on the flight line. The fire truck crew to which brothers Elmurza and Belmurza Bekmurzayev were assigned displayed particularly fine teamwork. Using a special foam, the airmen first fought back the flames and subsequently extinguished them entirely.

The men of the airfield company under the command of Sr Lt A. Katrichenko did an efficient job of repairing damage. They repaired the runway and taxiways. The pacesetter in this work was platoon commander WO F. Bokalo, a genuine expert at his job. After some time airfield company commander Sr Lt A. Katrichenko reported that all serious "damage" had been repaired. Indeed, new concrete slabs could be seen where there had recently been craters from mortar shells.

Work was also in full swing at the aircraft and ground vehicle decontamination station. The officer in charge of the station, Sr Lt N. Gorbunov, used special signal flags to have the next aircraft towed over for radiological decontamination.

The command post was steadily receiving reports on neutralization of the consequences of "employment" of weapons of mass destruction. Exercise results were good. This special tactical exercise, however, also pointed up shortcomings in the airmen's performance. For example, there was a certain amount of aimless running around and confusion during the exercise. Not all the men quickly gained their bearings in the complex environment and made correct decisions. There was consderable criticism directed against communications personnel and the men of the motor transport company. In short, there are plenty of problems to be solved in the near future. In order to eliminate deficiencies I feel that such exercises should be held regularly,

not sporadically. Airfield security and defense is important, and therefore people should have a serious attitude toward these activities.

3024
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SOVIET POSITION ON WORLD PEACE, SECURITY OUTLINED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 8-9

[Article, published under the heading "27th CPSU Congress: Aspects of Theory and Practice," by Candidate of Historical Sciences Col Yu. Silchenko: "Strategy of Universal Security"]

[Text] The problem of war and peace is the most acute of the problems today facing mankind. Never before has such a serious danger threatened our planet. But also never before have the forces of peace been so powerful. Our party has marched and continues to march at the head of these peace-loving forces. It was stressed at the 27th CPSU Congress that the main goal of the party's foreign-policy strategy is to ensure for the Soviet people the opportunity to work in conditions of a firm peace and of liberty. Therefore the struggle against the nuclear threat, the arms race, to preserve and strengthen world peace will continue to remain in the future a mainline area and direction of party activity in the international arena.

This task is not only extremely important but complex as well. It requires a thorough understanding of the problems of international affairs and those changes which have taken place in the world. All this has found scientific reflection in the documents of the 27th CPSU Congress.

Considering the new realities of today's world, the party congress formulated our general plan for international security. Its main points are as follows.

First of all, today no country is capable of defending itself solely with military hardware, with even the most powerful defense. The arms race cannot be won, nor can a nuclear war. In view of the nature of modern weapons, political means or, in other words, formal agreement taking into account the interests of all parties, with the aim of ending the arms race and stabilizing the world situation, are becoming the only way to guarantee security. Security is strengthened not by an arms race but by disarmament.

Secondly, security cannot be obtained at any country's expense or to its detriment. It can be only mutual security, as regards relations between the USSR and the United States, for example, or universal security, as regards the

international situation as a whole. Today security can be only security for all.

Thirdly, the United States continues to be the motive force of militarism. But the Soviet concept of security is grounded on an understanding of the fact that this U.S. policy is not in conformity with genuine U.S. national interests.

Finally, the CPSU takes into consideration the fact that today's world is very complex and is in the process of objective changes which cannot be impeded. In spite of its vast diversity, it is bound by a strong fabric of political, economic, cultural and other relations. Solution to the problem of genuine security requires active cooperation by all countries and consideration of the legitimate interests of each country.

Thus, emphasizes the CPSU Central Committee Political Report to the 27th CPSU Party Congress, today's world has become too small and fragile for wars and politics of force. We must resolutely and irrevocably put an end to a way of thinking and action which for centuries has been built upon the acceptability and permissibility of wars and military conflicts.

Imperialism, however, rudely ignores all these realities of today's world, which demand a certain restructuring of policy, awareness and approach to societal problems. Ignoring the will of peace-loving peoples and guided by class hatred toward the Soviet Union and the other countries of the socialist community, reactionary imperialist circles in the United States and the other NATO countries are fiercely resisting social advance and are attempting to halt the course of history, to undermine the position of socialism, and to recoup social losses on a worldwide scale. U.S. imperialism is the citadel of international reaction, the new revised CPSU Program stresses. The threat of war proceeds primarily from U.S. imperialism.

This conclusion is confirmed by the policy and practices of U.S. ruling circles. They have repeatedly hatched plans to attack our country. And in effect today in the United States is a unified comprehensive plan for the conduct of combat operations in the course of "a major strategic war," a plan which calls for delivery of nuclear strikes against tens of thousands of targets in the USSR and other socialist and developing countries. Having pretensions to world supremacy, U.S. imperialism proclaims entire continents to be zones of "vital U.S. interests" and interferes in the domestic affairs of many nations. Through the fault of U.S. imperialism there continues to remain a dangerous situation in Central America, in Southern Africa, and in the Near East. U.S. imperialism continues to wage an undeclared war against Afghanistan, on which it has already spent approximately a billion dollars. More than 150 million dollars worth of arms and military gear have been given to the Nicaraguan counterrevolutionaries.

Under the pretext of an imaginary "Soviet military threat" and the need to "defend national interests," the forces of imperialism and U.S. reaction are making intensive material preparations for another world war. The U.S. Administration has declared as its paramount task during coming years the attainment of military superiority over the Soviet Union. Never in the

history of the United States has the military budget grown so rapidly in peacetime as in the 1980's. In the last five years U.S. military expenditures have totaled more than 1 trillion dollars. The White House is seeking a 12 percent military budget increase in the coming fiscal year over the current one.

The lion's share of the enormous appropriations is going for the development of strategic offensive forces as a principal means of delivering a so-called disabling strike against the Soviet Union. Particular emphasis is placed on a long-range program to improve land-based, sea- and air-launched nuclear missile forces. The Pentagon is progressing at an accelerated pace with a military aircraft modernization and improvement program. The new B-1B bomber (range 16,000 km, combat payload in excess of 50 tons) became operational this year with the Strategic Air Command. Plans call for building and putting into service with the Air Force a total of 100 such aircraft by 1989. Each of these aircraft can carry up to 30 cruise missiles. A totally new strategic bomber, the ATB, is under development. It is the Pantagon's belief that modern air defense hardware will be unable to detect this bomber. More than 130 of these aircraft are to be built in the 1990's.

U.S. imperialism has built a vast war machine in its attempts to gain military superiority over the Soviet Union and the socialist community. Approximately 3 million men are presently under arms. In addition the Pentagon employs approximately 1 million civilians and supports more than 2 million persons employed in military industry. And the most active, efficient, and skilled portion of the ablebodied population is employed in military industry. Scientists and engineers comprise 30-50 percent of all persons employed at aerospace industry enterprises, for example.

One of the most important thrusts of U.S. imperialist strategy is expansion of the U.S. military presence abroad. In 1933 U.S. forces were stationed on the soil of three foreign countries, while in 1949 U.S. troops were in 39 countries, and today they are in more than 110. U.S. forces abroad total more than 540,000 men. So-called "rapid reaction forces" have been established for the purpose of aggressive brigand actions in various parts of the world. Washington currently maintains more than 1,500 bases and other military installations on foreign soil, facilities which are directed primarily against the Soviet Union and the other countries of the socialist community.

The continued deployment of new U.S. first-strike nuclear missiles in a number of West European countries is causing considerable concern. Japanese soil and the waters around Japan, as well as South Korea are packed with U.S. nuclear weapons.

U.S. plans to militarize space present a particular threat to the cause of peace. By deploying offensive weapons in space, the United States is counting on gaining military superiority over the USSR and obtaining the capability to threaten a nuclear first strike. The Pentagon has requested a 75 percent increase in "Star Wars" appropriations in the new fiscal year.

Similar military preparations are also being carried out in other countries of the aggressive NATO bloc. Addressing the 27th CPSU Congress, USSR Minister of

Defense MSU S. L. Sokolov noted that this military bloc's aggregate forces in Europe total more than 3 million men, approximately 17,000 tanks, more than 4,000 combat aircraft, and more than 7,000 nuclear munitions. For the most part these are very large, professional military forces, which are engaged in intensive training and preparations.

Thus a genuine threat of initiation of war against the Soviet Union and the other socialist countries, the threat of another world war and a nuclear catastrophe is being created, a threat contained in the policies of imperialism and in the practical actions of its most reactionary militarist, aggressive circles.

At the same time the CPSU, it is stressed in the proceedings of the 27th CPSU Congress and June (1986) CPSU Central Committee Plenum, proceeds from the position that there is no fatal inevitability of world war, no matter how great the threat to peace. War can be prevented and mankind preserved from catastrophe. In reaching this conclusion, the Communist Party was guided by the teachings of V. I. Lenin, who taught us to approach innovatively, not dogmatically the tenet of Marxism on the logical occurrence of wars with the domination of capital. He noted that periods of time are possible when the imperialists will be virtually unable to unleash war. The objective factors of peaceful coexistence have broadened considerably in our time, and the potential of peace has increased greatly, serving as a powerful barrier to the reckless military adventures of imperialism and a world nuclear missile catastrophe.

These include first and foremost a vigorous, consistently peace-seeking policy on the part of the socialist states and their growing economic and defense might. Not only the establishment but also the guarantee of preservation of the military-strategic parity between the USSR and the United States, between the Warsaw Pact and NATO is a historic achievement of world socialism, it was noted at a meeting of the Political Consultative Committee of the Warsaw Pact member nations held in Budapest on 10-11 June 1986. The capabilities of imperialism have decreased, and the leaders of the capitalist world are compelled to face this fact.

Another factor is the steadily growing awareness of the fact that today not only nuclear war but the arms race as well are unacceptable to all peoples. In forcing military competition on us, capitalism was counting on undermining the economic potential of socialism. Today, however, it is becoming clear that present military expenditures are an intolerable luxury even for the United States, the wealthiest country in the West, resulting in an enormous national debt exceeding 2 trillion dollars. The arms race has led to a situation where today more than 33 million persons in the United States are living below the poverty level, there are 5 million homeless, and millions are living on the edge of starvation. Economic problems also engender political conflicts. Today one can no longer consider the capitalist coalition which opposes us as a unified whole. The United States, taking the most extremist position on a number of international issues, does not necessary enjoy the support of all its allies.

And, finally, political and social forces which consciously or objectively champion peace have grown substantially today, another important factor.

Soviet foreign-policy strategy takes into consideration all the factors enumerated above. The CPSU proceeds from the position that in today's world, filled with sharp conflicts and faced with threatening catastrophe, in conditions where two socioeconomic systems fundamentally differ both in willingness and capability to comprehend and resolve the problems which arise, awareness and affirmation of the Leninist idea of peaceful coexistence is of particular relevance and value. The issue in question is not only that of eliminating war from the experience of society but also rejecting harsh, violent forms of confrontation and expanding mutually beneficial cooperation in various areas, including resolving global problems. "Soviet policy," noted CPSU Central Committee General Secretary Comrade M. S. Gorbachev in his closing address at the 27th CPSU Congress, "is focused on searching for mutual understanding, for dialogue, for affirmation of peaceful coexistence as a universal standard in relations between nations." And this is demonstrated by our specific actions and proposlas. In a speech at an official ceremony to award the Order of Lenin to Vladivostok, comrade M. S. Gorbachev put forth new, constructive initiatives aimed at stabilizing the situation in Southeast Asia, at nonproliferation of nuclear arms in Asia and the Pacific, at reducing naval activities, military forces and conventional arms in this region, and at moving forward to practical discussion of confidence-building measures and renunciation of force in this region. The decision to withdraw six regiments with their arms and equipment from the DRA by the end of 1986 represents an important step by the Soviet leadership toward reaching a political settlement of the problems involving Afghanistan.

The CPSU considers implementation of programs of total and universal elimination of nuclear weapons and other weapons of mass destruction as well as reduction of forces and conventional arms by the end of the 20th century to be a central foreign-policy thrust in coming years.

The 27th CPSU Congress advanced the idea of establishing an all-encompassing system of international security and formulated its basic fundamentals. They are of a comprehensive, combined, constructive character. All aspects of the modern concept of international security are brought together for the first time -- military, political, economic, and humanitarian. In the military domain such a system is grounded on renunciation by the nuclear powers of war against one another or against "third countries" -- both nuclear and conventional. It proceeds from the necessity of preventing an arms race in space, bringing an end to all testing of nuclear weapons, scrapping nuclear weapons, banning and destroying chemical weapons, and renouncing other means of mass annihilation. The military potential of nations would be reduced under rigorous monitoring procedures, military blocs would be disbanded, and military budgets would be reduced in a proportionate and commensurate manner.

The other brother parties support this realistic position taken by the CPSU. Their unity of position was expressed in a formal appeal by the Warsaw Pact member nations to the NATO member nations and to all European countries, offering a program of reduction of military forces and conventional arms in Europe.

We should state that the United States also advocates effective measures in the area of disarmament. But the U.S. leaders' words are at disparity with their deeds. Confirmation of this is their response to Soviet proposals. All statements made by the U.S. President since the 27th CPSU Congress have been permeated with the idea that the United States should and will arm and that its policy should be and will be a policy "from a position of strength." The Washington Administration has essentially declared an "arms control war." President Reagan has announced that he will no longer be held to the SALT II limits. In confirmation of this he gave instructions to begin arming B-52 strategic bombers with cruise missiles by the end of the year.

In conditions where the imperialist states not only reject our peace-seeking proposals but are also stepping up military preparations, the CPSU considers it essential to continue in the future organically to combine in our policy a tireless campaign for peace with practical steps to strengthen national defense. "The Soviet Union does not seek greater security," it was stressed in the CPSU Central Committee Poliical Report, "nor will it accept less."

The present world military-political situation and the interests of security of our homeland and the nations of the socialist community demand that the Soviet Air Forces be prepared at all times to inflict a crushing defeat on an aggressor. This requires a continuing all-out effort to increase political vigilance and to ensure a high degree of military forces combat readiness. Each and every military airman must work persistently to master the new-generation aircraft, modern tactics, combat performance standards, and to strengthen military discipline and organization.

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TU-20 FLIES OCEAN RECONNAISSANCE MISSION, BUZZED BY NATO FIGHTERS

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[Article, published under the heading "Report From Aloft," by Maj A. Zhilin, AVIATSIYA I KOSMONAVTIKA special correspondent: "Over Neutral Waters"]

[Text] The weather was beautiful around the airfield from which we were to take off on a mission with the crew of a long-range bomber. The bracing aroma of warmed soil and the perfume of flowers were most invigorating.

I wanted to do a bit of dreaming about the future prior to departure. For us Soviet citizens these dreams most frequently involve accomplishing the magnificent tasks of peaceful construction and development advanced at the historic 27th CPSU Congress. Airmen were about to take off on a long mission, which would last many hours, so that the hopes and aspirations of Soviet citizens can come to pass, so that no evil force will disturb our people's productive labors. An awareness of enormous responsibility for the security of the homeland which rests on their shoulders compels these courageous men mentally to gather and compose themselves and heightens their vigilance. All personal cares are left behind. During a mission only the interests of the homeland are advanced to the forefront, and I am sure that each and every crew member would be willing to sacrifice his life at a stern hour of ordeal.

...The crews of the two aircraft gathered together for a few minutes. A final briefing on the details of the imminent mission. Honored Military Pilot USSR Vladimir Kobtsevich, commander of the lead aircraft, looked at his watch.

"Synchronize watches. 0945 -- mark! Board your aircraft!" he ordered.

I was going to fly with Military Pilot 1st Class Maj A. Bazanov's crew. He is a seasoned veteran, who has seen and experienced a great deal during his career in the Air Forces. It is probably for this reason that he is a man of few words, stern in appearance and restrained in manner. In short, a truly manly character and personality, a man of integrity, toughened and conditioned by the sky.

We climbed up the ladder into the aircraft. From the ground it looked impressively large, but on entering the aircraft one had to keep alert both to

the right and left in order to avoid accidentally snagging a panel switch. There was just enough space to accommodate the crew, with the remainder of the space occupied by various equipment.

I found myself a seat on a parachute between the crew chief [senior flight technician] and navigator. As the crew prepared to fire up the engines, I gazed around the flight deck. There was plenty of visibility: windows both to the left and right. And, the main thing, I could observe the crew at work without bothering anybody.

Engine start! The cabin filled with the roar of powerful engines, sounding like the leitmotiv of a symphony of distant flight. The aircraft gave a shudder and proceeded to taxi out toward the active. Brief commands crackled in my headset. Cleared for takeoff! The airspeed indicator needle smoothly advanced to the right. The knocking of the wheels over the concrete runway slab joints increased in frequency. Then the jolts and vibrations diminished and ceased altogether. The altimeter needle proceeded to move, indicating tens and hundreds of meters as we climbed out. Through the glazed nose I could see the ground receding rapidly.

Within a few minutes the aircraft was solidly wreathed in clouds. The flight deck became much darker and somehow less friendly. Soon, however, bright sunlight flooded in, sunbeams bouncing playfully off the glass on the instruments. The alert, serious faces of the crew members stood out in greater contrast against the friendly atmosphere generated by the bright sunlight. Each crew member was absorbed in his job.

Navigators Maj V. Lozhkin and Capt V. Boyko hunched over charts on their narrow desktops. The two of them comprised the crew's principal nerve center, as it were. Heading, altitude, airspeed, flight level, en route waypoints, checkpoints, bearings, drift angles, and a great many other items had to be calculated and checked. Thanks to these efforts, the aircraft was flying precisely on its predetermined route. It would be a long flight, and navigational accuracy was of paramount importance.

Even during the flight Viktor Boyko's fun-loving Ukrainian personality was clearly in evidence. In spite of his workload, the navigator found time to ask the other crew members how things were going and to joke around. This had the effect of lightening the atmosphere and easing the monotony.

His colleague Vladimir Lozhkin, an ethnic Komi, is the exact opposite of his comrade. Severe of mien, untalkative, preoccupied, totally absorbed in his work. He reported information to the pilot in short, clipped sentences, each word of which was precise, and nothing superfluous. Vladimir has logged 1,700 flying hours.

...We were continuing to climb. It was becoming more difficult to breathe. It felt like you were climbing uphill with a heavy pack. I had to reach for the oxygen mask with increasing frequency. There were almost no clouds now, and visibility was excellent. Forests, villages, and large squares of kolkhoz fields were passing under us. Warmed by the sun and encouraged by the

farmer's hand, the land was preparing to repay man with a generous harvest for his blessed labor.

Villages alternated with towns. A scene not out of the ordinary, but at the same time inspiring. One's heart filled with pride at these boundless expanses, at the magnificent scale of our peacetime construction.

The cockpit clock already indicated several hours aloft, which had passed almost unnoticed in the crew's work routine. The only indicators were a heaviness in the shoulder and back muscles and a numbness in the legs. The mission was far from over, however!

The sun continued beating down mercilessly. I was really getting thirsty, but I remembered the warning about taking in too much liquid. I would just have to wait.

The scene below changed. We were now flying above the glistening corrugated silvery surface of the sea. The crew's workload intensified. We were now over featureless terrain. All attention was now focused on the instruments.

Neutral waters. The copilot, Military Pilot 3rd Class Lt M. Zvyagintsev, vigilantly maintained an airspace scan. Mikhail, the youngest crew member, had only logged a few hundred hours. A native of Uryupinsk, he grew up in a normal working-class family. He likes sports and fishing. He loves flying, as he puts it, because of the opportunity to put oneself to the test.

As the aircraft reached neutral waters, radio conversation dropped off. One sensed that the crew members were mentally gathering themselves. Suddenly we heard in our headsets a characteristic brief sound like the muffled quacking of a duck. It signified that our aircraft was being painted by radar. But where could the radar be located, so far from shore? Evidently there were aircraft not far off. Whose aircraft? For what purpose had they grasped our aircraft with their electronic tentacles? At the moment there was no ready answer to these questions. One thing was clear: they were not ours.

Radio operator WO A. Skoryy, seated under his transparent dome, was turning his seat in a 360 degree circle, maintaining a visual airspace scan. He was also maintaining communications with the ground. It was he who held that invisible thread connecting us to our native shore.

Aleksandr had started as a private in the Air Forces. He had really taken to the service, as they say, and therefore decided to make the military his career.

"Two aircraft at 6 o'clock," the warrant officer informed the pilot over the intercom.

A minute or two later I spotted them. A pair of brightly-painted F-16s, belonging to a capitalist country, were approaching out of the sun. Air-to-air missiles glistened under their wings and fuselage. For some time the fighters rode abeam of us, as if scrutinizing our aircraft. Then, moving in closer, they proceeded to do a carousel-like dance around our aircraft. Their

humpbacked, needle-nosed fuselages flashed to port and starboard, above and below us, ahead and abaft. I figured that this was probably a "psychological attack" on the Soviet fliers.

But our crew was not to be intimidated. Over their years of service in Strategic Aviation, our airmen have developed a solid immunity to the various acts of provocation performed by NATO air pirates. I looked at the crew members. All their faces were calm. Lieutenant Zvyagintsev was smiling, pointing to the fighters and unambiguously twirling his index finger at his temple. Only the crewmen's eyes, stern and alert, communicated the fact that the situation was serious.

Apparently realizing that they would accomplish nothing with their provocative maneuvers, the NATO pilots decided to try something else. One of them went off in pursuit of the leader, while the other proceeded to close on our aircraft. The distance between us closed to 150... 100... 50 meters.... The aircraft, with an enormous rooster painted on its tail fin, literally hung suspended above our port wing. We could see the pilot's face clearly: smug and insolent. From time to time he would dip his wing left, showing us his missiles. Then, releasing his control stick, he made a big show of photographing our aircraft, holding a camera in his hands. After this the fighter broke away.

While I was observing the F-16s I failed to notice that that air situation had changed. A pair of Phantoms had approached to a close position starboard. They were followed by others.... It was apparent from their markings that the aircraft belonged to different capitalist countries.

Another pair approached and, judging by the fact that a "Victor" tanker aircraft appeared to our left, they were not planning to ignore us. After topping off their tanks, they returned to us, demonstrating their derring-do flying skills. One after the other, the aircraft executed chandelles and simulated attack passes, alternating from forward of and behind our wingline. Streaking over us, these aerial pirates sought to buffet our aircraft with their wake turbulence and to impede them from maintaining heading which, incidentally, international agreements strictly prohibit. We were minding our own business, disrupting nothing and threatening nobody.

During these moments I recalled a story about similar air encounters related by Vladimir Yevgenyevich Kobtsevich, the lead pilot of our two-ship element. He has seen a lot in his day. Once a fighter pulled out in front of the aircraft he was piloting and lit his afterburner. This was done deliberately to cause the Soviet aircraft's engines to surge. On another occasion an American aircraft had positioned itself between a Soviet bomber and tanker aircraft, preventing them from accomplishing a hookup.

Observing the air situation, I was witness to the following scene. A Boeing was positioned at our 6 o'clock high. Judging by the fact that he had been tailing us for quite some time, he was directly involved in the events taking place. He was probably handling overall control of the fighters.

In this situation gun armament officer Maj V. Kotsyuba was closely watching the movement of each fighter, instantly reporting all new developments to the pilot. From a psychological standpoint it was perhaps more difficult for him than all the others, since he was out of direct and immediate contact with the crew members.

Our fighter escort did not limit itself merely to "intimidation" maneuvers but was attempting to jam our radios. Sometimes we could hear nothing but static in our headsets. Sr Lt V. Yemets went to work. From a coal-mining family, he had been planning to go to work in the mines, just as his father had done. During his term of service in the Air Forces, however, he decided he really liked it and wanted to make a career in military aviation.

We had been in the air almost 8 hours, but I did not yet feel too tired. Apparently awareness of what was happening around us was holding back a feeling of fatigue. Our pursuers would back off, then come in quite close and resume their insane game of shadowboxing. A Phantom streaked over us, missing by a few meters. His wake turbulence shook our aircraft, causing the instrument needles to quiver slightly.

Crew chief Capt L. Bezverkhniy, an experienced specialist who has logged more than 1,500 hours in the air, kept a close watch on them. He is the aircraft's custodian. On the ground he readies it for departure, and in the air he is responsible for reliable operation by the engines, other systems and equipment. In short, the flight technician has plenty to do. And he does an excellent job. Proof of this is the title of unit excellent aircraft, which the aircraft has held for several years running.

The instruments indicated that all systems were operating normally, a fact which Captain Bezverkhniy reported to the pilot. "Roger," Major Bazanov replied. He immediately radioed the leader. "Skipper, a pair of Phantoms at 5 o'clock."

"Roger," came Kobtsevich's calm reply.

As I listened to the laconic communications between crew members and aircrews, I suddenly thought about the fact that, in an atmosphere of military blackmail and threats created by the imperialist countries, a legitimate apprehension about the world's fate had formed in the consciousness of each and every one of us. Here in the air it was clearly apparent how easily things could come to a military clash and what enormous efforts our party and government were undertaking to restrain aggressive actions by the militarists and to defend world peace.

Some time later the sky became bright orange, and shortly thereafter transitioned to a layered spectrum of contrasting shades of lilac, claret, and red. Sunset! A thin sliver of sun, which appeared to be radiating painted-on rays, bade us farewell and slipped below the horizon. Dusk fell swiftly, soon to be followed by pitch blackness. A multitude of instruments glowed with green eyes in the semidarkness. The monotonous roar of the engines had a lulling effect. My inner biological clock, having grown accustomed to a rhythm developed over the years, told me it was time for bed. This was a most

unpleasant sensation. How could I sleep now, with several hours of flying still ahead?

The air situation had become calm; our pursuers had left us in peace.

"Supper time," I heard Sr Lt Vasiliy Yemets's voice in my headphones.

The flight deck was filled with the rustling of cellophane meal pouches. Today's supper menu included meat pie, apple juice, pastry, and chocolate. Vasiliy prepared coffee for the crew. On flights he also performs the duties of volunteer cook and, judging by all appearances, he does a good job.

In the meanwhile the sky had become dotted with bright stars. Reflecting off the sea surface, they made things look like in a fairy tale: it was as if we were motionless at the center of a vast stellar world. One loses all sense of time and space in this unfamiliar environment, and it is difficult to get an immediate picture of whether one is looking up or down. I looked at the artificial horizon to break the illusion -- it indicated we were straight and level.

It is rather difficult to achieve spatial orientation in such conditions. And it was evidently for good reason that the aircraft's navigators were checking their instruments with increasing frequency, constantly updating the aircraft's position. The aircraft commander, Major Bazanov, flew with assurance, adjusting to their corrections.

Another hour passed. I could see a shoreline below. Now everything resumed its normal place: a star-filled sky overhead, the earth below -- our beloved Soviet soil. I immediately sensed a feeling of inner relief and relaxation. We were back home again, although it was still quite some distance to the base.

We flew over a large city. I gazed down at its night lights and, after everything I had experienced in the air this day, I had a sharper sense of the great value of a peaceful, tranquil life. What enormous happiness to be confident about tomorrow! And I could not help but think to myself that only those to whom the future of mankind is a matter of indifference are capable of refusing to accept our country's peace initiatives. Nevertheless I believe that justice and reason will triumph.

They say that the trip home is shorter and faster. Perhaps this is so, but nevertheless the final hours of the flight dragged on interminably. I was really tired. My eyes kept drifting over to the clock: when would the hands finally advance to our ETA? The clock hands seemed to be moving twice as slowly. No wonder the sound of the outer marker conjured up a vision of the finish tape just ahead. Only a few seconds remained, but these were the most difficult -- the landing. The runway, flanked by runway lights, was clearly visible. A smooth flare, and an instant later the wheels smacked down onto the runway surface.

After climbing down onto the ramp, we stood for some time silent under the aircraft. During these moments I gained a clear understanding of the complicated, difficult job of these fine men, the result of which is peaceful tranquility....

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ACHINSK MILITARY AVIATION TECHNICAL SCHOOL

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 23-26

[Article, published under the heading "Military Educational Institution Affairs," by Col V. Barabash: "Achinsk Military Aviation Technical School"]

[Text] The cadets were frozen at attention in formation by the climbing aircraft monument. The stern, content-filled words of the military oath of allegiance rang out. Henceforth these young men would be members of the military, joining the ranks of armed defenders of the homeland.

Future aviation technicians spend their first years of military service at the Achinsk Military Aviation Technical School imeni 60th Anniversary of Komsomol, where a foundation is laid down for their professional skills, and where fortitude, staying power, and courage are developed, without which one cannot accomplish assigned missions skillfully and promptly.

In the decades of this school's existence there has been formed here a teaching faculty with a great deal of practical experience in servicing and maintaining aircraft, who possess thorough knowledge of education science and solid professional skills. The graduates of this school always remember with gratitude commanders and political workers, teachers and instructors F. Chumak, I. Redka, M. Kantor, A. Golubev, Ye. Babin, I. Shestitko, P. Panov, I. Kozlov, I. Rzhavin, V. Alekseyev, and others.

This school has trained tens of thousands of qualified specialists for this country's Air Forces. The school's Board of Honor carries the names of 235 graduates. The very best have been given the honor of representing the Air Force Komsomol at All-Union Komsomol congresses: Cadet G. Galkin, an excellent student, at the 17th Congress, and Sr Sgt V. Tsyura, Komsomol stipend recipient, at the 19th Congress.

Graduates of this school are serving in all military districts and groups of forces. They are working conscientiously, providing reliable aircraft servicing and maintenance. Hundreds of the school's former students have been awarded coveted government decorations. School graduates officers V. Shemun, V. Mishutkin, V. Perminov, V. Steyngauer, A. Berestov, S. Ovechin, and others were recently awarded government medals and decorations for valor and courage

displayed while performing their internationalist duty in the DRA. Good reports are received from the line units. Recently, for example, the diligence and skill of officers O. Dyrda, V. Klepfert, V. Protopopov, V. Kazarov, and S. Sysoyenko were commended.

Many officers who have graduated from this school have subsequently gone on to a higher education, becoming doctors and candidates of sciences, professors and docents, and highly-skilled maintenance engineers. Some of them have returned to their alma mater to teach, passing on their knowledge and experience to the young cadets. Subunit and areas of study officers Col P. Lishchishin, Lt Col A. Savenko, Majs G. Zhmak and A. Flusov, Capt V. Kovalev, Sr Lt A. Ivanov, and others devote a great deal of effort and productive energy to teaching and instructing the cadets.

A stela has been erected by the entrance to the school: caring hands are gently supporting an aircraft in flight. This symbol reveals the meaning and purpose of the difficult but important and needed labor of officer-technicians, who must not only possess solid skills in servicing and maintaining modern aircraft but must also possess solid knowledge of theory, extensive military technical knowledgeability, and must be ideologically convinced, physically, morally and psychologically fit defenders of the homeland. They must have the ability to do a quality job of servicing and maintaining an aircraft, ensuring failure-free equipment operation, and teach and indoctrinate mechanics taking into account the tough demands of modern combat.

The entire training and indoctrination process is directed toward forming qualities essential to today's aviation technician. Much has been accompished, but there is still work to be done. In conformity with the requirements of the 27th CPSU Congress and party decisions pertaining to a radical restructuring of higher and secondary specialized education, considerable attention is being focused on development and improvement of training facilities and expanding military-scientific and efficiency innovation activities. By engaging in technical innovation, cadets learn to think, to find unique solutions, to apply new and advanced concepts in studying aircraft equipment, and learn not to become flustered in a complex combat training environment. Many of them are Lenin and Komsomol stipend recipients.

At this school they seek to find the most effective, efficient forms and methods of teaching and indoctrination. Considerable efforts are being made to intensify the learning process, especially cadet independent study. An automated-learning classroom extensively employing audiovisual aids has recently gone into operation and is being successfully utilized. Programmed learning is being aggressively adopted. A great deal of credit goes to Lt Cols V. Rafayevich, V. Spiridonov, and V. Nikolayenko, Majs U. Kadyrov, V. Veselkov, and others. The teaching faculty and instructor personnel seek to ensure that every graduate is a fine example on his job and in discipline, possessing the requisite command and methods skills and with the ability intelligently to conduct political indoctrination work.

The party and Komsomol organizations, working under the guidance of the political section, set the tone in civic activities. The revolutionary and labor conditions of the city and surrounding area are widely publicized. The "Poisk" [Quest] Club formed at the school arranges get-togethers between students and veterans of the Great Patriotic War as well as workers employed in the Kansk-Achinsk Fuel and Energy Complex, and corresponds with graduates. Annual Achinsk-Abakan-Shushenskoye agitation runs, in which the best cadets take part, have become a tradition. The city's preinduction-age youth attend the "Aviator" Military-Patriotic School, many graduates of which later enroll at the Achinsk Military Aviation Technical School.

A new academic year has begun. Another page has been opened in the school's glorious history. Soon a large detachment of this school's graduating cadets will join the ranks of aviation specialists. Our complex aircraft are in reliable hands.

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TRAINING PILOTS TO RESPOND TO INFLIGHT EMERGENCIES

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 26-27

[Article, published under the heading "For a High Degree of Flying Efficiency and Flight Safety," by Military Pilot 1st Class Gds Col P. Ponomarenko: "Preparedness for Danger"]

[Text] Sr Lt A. Baranov was to fly a performance-graded intercept of a target flying above cloud cover, in marginal VFR conditions. It was a routine training sortie, and it seemed nothing could keep him from accomplishing it.

Suddenly the aircraft entered clouds. Senior Lieutenant Baranov maneuvered abruptly to get out of them. His instruments indicated that he was in a far from routine flight configuration. A bolt of alarm shot through him. He realized that he would be unable to accomplish the mission....

Following a thorough analysis of the incident, the conclusion was reached that one of the reasons for failure to accomplish the task was the pilot's poor individual psychological qualities, his inability quickly to evaluate the situation when conditions deteriorated and to perform flawlessly and with precision.

When assessing the readiness of a pilot (aircrew) for effective accomplishment of a training sortie, the main criteria include level of flight training and its quality, reliability of aircrew performance aloft, and their psychological and emotional ability to stand up to sharply altered conditions of flight. Reliability is defined as a pilot's capability to maintain his working efficiency in the face of greater complexity or deterioration of the conditions in which the mission is being formed.

The terms effectiveness, efficiency and reliability are not always equivalent in meaning. While effectiveness and efficiency, determined by the accuracy and quality of task performance by the pilot, are rated by the end result, reliability depends in large measure on the cost at which the result was achieved, as well as the degree of neuroemotional stress in the process of the pilot's activities.

Experience indicates that the greater a person's emotional stress, the less reliable his actions will be. Commanders must bear this in mind when training and preparing pilots for flight operations and must take effective measures to increase their emotional and physical tolerance to the effect of those factors of flight which affect one's job performance and working efficiency in the air. Practical experience indicates that in actual conditions a pilot's reliability can be predicted on the basis of an assessment of his state of psychophysiological performance capability to carry out a task in a normal situation and his preparedness to perform in an emergency situation, as well as his physiological resistance to environmental factors.

No matter how reliable an aircraft may be, when flying a mission there exists a certain probability of special situations which create emergency conditions in flight. The most typical are aircraft equipment malfunctions, as well as damage to an aircraft by hostile actions in combat conditions. Any malfunction during flight inevitably causes heightened emotional agitation in a pilot. A difficult situation can also lead to certain changes in mental and emotional state and in the structure of the pilot's activities, that is, to stress. A pilot's reaction speed increases in a state of moderate stress, but the number of mistakes he makes also increases. Errors of perception appear with increasing stress, scope of attention narrows, attention distribution and switching change, and a pilot omits some procedures.

In an emergency situation a pilot is forced to alter his established model of in-air actions and procedures. There occurs disruption of his information processing activity stereotype which was formed in the process of practical flying. Attention is split between actions to continue flying and actions to come up with a new, frequently unforeseen solution. Sensorimotor disturbances also occur: coordination and precision of movements deteriorate, applied forces become disproportionate, the pilot grips the control stick tightly, reads his instruments slowly or incorrectly, and does a poor job of perceiving commands and instructions.

Emotional stress has a substantial effect on reliability of the pilot's actions and flight safety, and therefore regular and systematic psychophysiological training is essential. It alone can ensure that a pilot is psychologically prepared to act in an emergency, rapid restructuring of the nature of his activities and ability, against the background of his principal inflight work procedures, to perform additional work when an emergency arises.

For example, here is how such training is conducted in the squadron in which Gds Lt Col V. Repin serves. It is grounded on mental modeling of actions and procedures in the process of studying the pilot's manual, and practice drills in the aircraft cockpit (simulator) working on emergency situations separately and subsequently together with flight assignments. At first pilots work alone with the manual, memorizing malfunction warnings and symptoms, the nature of a malfunction based on warning lights and aural warnings, sequence of cockpit work procedures, and decision on subsequent actions (to continue or abort the flight and return to the field, or to eject). They then work on actions and procedures in the cockpit (flight simulator) in response to an instructor's scenario instructions. Such a practice session includes detecting and determining a malfunction by simulation or oral scenario instruction, cockpit

procedures, and decision making on the basis of the nature of the malfunction and scenario-specified flight conditions (altitude, aircraft's location, and mission). Pilots then proceed with practice sessions to form skills in performing in emergency situations in the dynamics of flight. At the first session the instructor briefs the trainees on the nature of the probable equipment malfunction. After the pilots have solidly mastered flying procedures with precise switching to procedures in an "emergency" situation, malfunctions are simulated without warning. The instructor rates the pilots' psychological preparedness for actions in emergency conditions at all phases of training. He pays particular attention to preparedness to respond during such phases of a flight as takeoff and landing.

Practical experience indicates that following solid reinforcement of skills, pilots must practice on a regular basis in order to maintain the developed pattern of response. This is why every training class, practice session and drill conducted in the subunit ends with a detailed critique with performance grading. Pilots' preparedness to operate in emergency conditions is rated on the basis of two indices: "prepared" or "unprepared." In assigning a grade, one considers the trainees' ability quickly to reorient their thinking toward continuing the flight, to perform the required procedures precisely and promptly, and to fly the aircraft. The most objective grade in such instances is given after sessions on the flight simulator as well as on the basis of observations of pilots' performance in actual flight conditions when they are faced with a difficult situation.

A great many elements are considered in rating a pilot's preparedness to perform a mission, including actions in an emergency. The large number of diverse and interlinked factors which affect his degree of readiness oblige the Air Force commander to be very careful in determining whether or not the pilot is ready to fly. Failure to consider any of these factors or any of their interlinkages can result in clearing for flight a pilot who is ill-prepared to fly. This can result both in failure to accompish the mission and a threat to mission safety.

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HAZARDS OF FLYING IN ICING CONDITIONS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 28-29

[Article, published under the heading "Constant Attention to Flight Safety," by Col A. Kurgan and Candidate of Geographic Sciences Col D. Finogeyev: "'In an Icing Zone'"]

[Text] The unit weather officer, Maj Yu. Yakovenko, was giving a preflight weather briefing: "In the airfield area, stratus with bases at 200 and tops at 700 meters, visibility 2-3 kilometers below the cloud cover due to haze."

The officer devoted particular attention to the fact that there were icing conditions in the clouds. However, neither the flight operations officer, Lt Col N. Mezentsev, nor the aircrews paid serious attention to this warning.

Flight operations commenced. And immediately crews which had taken off into the overcast sky began reporting that their helicopters were commencing to pick up ice.

Capt V. Bolshakov switched on his anti-icing system and took off. He climbed to 600 meters and turned to his enroute heading. Outside air temperature was -12 degrees C. Soon a rapid buildup of ice began. The pilot reported back to the tower but failed to get out of the icing zone, as required by the Manual of Flight Operations. Twenty-six minutes after takeoff they heard a knock in the general area of the engines. Starboard engine rpm began to drop. Captain Bolshakov reported the engine failure to the flight operations officer and, receiving authorization, proceeded to land his helicopter on one engine onto a forced-landing site.

A subsequent inspection revealed that the engine shutdown had been caused by icing. But the anti-icing systems had been on. What was the problem? The problem was that the crew had failed to follow the procedures prescribed for a helicopter of that type, which prohibit flying in icing conditions at an outside air temperature below -10 degrees C. At such temperatures the engine's anti-icing system cannot handle the ice buildup, and ice begins to form on engine internal air ducting surfaces, which leads to change in ducting shape and dimensions, reduced flow, and a drop in engine power. This can cause malfunctions in compressor operation and engine failure.

All modern fixed-wing and rotary-wing aircraft are equipped with special high-output anti-icing and deicing systems (POS), which provide protection even in highly adverse conditions. For example, when the outside air temperature is below the minimum specified in the operating manual, brief-duration flight in icing conditions, with intelligent use of the POS, does not present a serious danger. If vigorous measures are not taken, however, to get out of the hazardous conditions, continued flight can lead to deterioration of aircraft performance and in certain instances to equipment failure.

For example, once a bomber crew encountered light icing and requested an altitude change. It took 30 minutes to receive clearance. During this time bits of ice breaking off by the force of the airstream on those parts of the aircraft not protected by anti-icing gear entered the engine air intake ducts and dented several compressor blades.

As we know, an aircraft encounters the heaviest icing conditions in the upper part of summer towering cumulus and cumulonimbus clouds. For this reason it is prohibited to fly in such clouds. Sometimes, however, an aircraft accidentally gets into such conditions. This happens most frequently due to the crew's inability to detect heavy cumulus and cumulonimbus buildup with their airborne radar. The aircraft's safety may become seriously threatened in such situations.

Once while flying at an altitude of 7,800 meters, an Il-76 aircraft unintentionally entered cumulonimbus clouds, where it encountered heavy icing, with ice building up at a rate of 5 mm/min. Soon the airspeed indicator and several other control, performance, and navigation instruments went out. The crew was forced to land at an alternate airfield.

Incorrect use of the POS during landing and takeoff presents a serious hazard to flight safety. During these configurations, with flaps extended and at low airspeeds, the degree of influence of wing and stabilizer icing on aircraft stability and controllability increases considerably.

Pilots should clearly understand the physical substance of icing in order correctly to utilize the methods which have been developed to combat this hazard. In landing configurations, for example, the horizontal tail is at considerable negative angles of attack close to critical. Under the effect of icing, premature stalling occurs on the lower surface of the horizontal tail. This results in a progressing pitch-down tendency, which in close proximity to the ground can lead to a crash. For this reason it is recommended that the flaps be extended gradually, at a sufficient altitude.

Longitudinal stability and controllability characteristics deteriorate to a particularly considerable degree during icing of aircraft with the wings positioned high in relation to the stabilizer, which in this instance is in the wing's aerodynamic shadow.

During takeoff in icing conditions, an aircraft's performance sharply deteriorates as ice builds up on the surface of the aircraft: drag increases, lift decreases, and stalling speed increases. In addition, turbulent airflow

across an aircraft with impaired aerodynamics creates conditions for buffeting, which makes flying the aircraft more difficult.

Retraction of flaps restores normal airflow, and shaking or buffeting diminishes. The lift coefficient also decreases, however. If this is followed by decrease in engine thrust from takeoff to normal climb setting, the pilot will be forced to increase his angle of attack to maintain rate of climb. But since wing icing causes a decrease in critical angle of attack, the danger of entering stall conditions increases. In order to prevent this, it is recommended that abrupt increase in angle of attack be avoided.

It is particularly hazardous to take off in an aircraft the surface of which is covered with snow, frost, or ice. Liftoff speed increases, and rate of climb decreases. The result is an increased danger of running beyond the runway end on the takeoff roll or colliding with ground obstacles along the runway extended. This happened at Washington National Airport on 13 January 1982, when a Boeing 737 crashed. After liftoff the aircraft was unable to climb, struck a bridge spanning the Potomac River, and plunged into the water. An investigation revealed that the passenger aircraft had taken on ice while on the ground. Prior to taxiing from the ramp, the aircraft was hosed down with deicing fluid, but a 50-minute departure delay and poor quality of the deicing fluid resulted in the aircraft icing up again. In addition, the crew worsened the situation by failing to switch on the engine anti-icing system while on the ground, and this resulted in diminished engine thrust.

The hazard is much greater when an iced-up aircraft takes off in adverse weather conditions. Under these conditions the ice builds up very rapidly, since water droplets freeze on contact with the rough ice surface rather than running off as is the case on clean aircraft skin. For this reason it is absolutely prohibited to take off in an aircraft carrying ice.

In order to ensure flight safety, an aircrew should be informed of potential icing conditions and have the ability correctly to employ its POS in conformity with weather conditions. Another reason this is important is that forecasting of icing conditions is difficult. At the present state of the art of practical weather forecasting, it cannot be fully accomplished taking into account all factors which promote the occurrence of this phenomenon. The fact is that icing conditions are determined from the following principal parameters: air temperature at an aircraft's flight level, temperature of the surface of the aircraft, quantity and size of supercooled water droplets. This last parameter, the most important, is not determined by standard weather service technical means.

In the methods used to predict icing, the influence of these parameters is taken into consideration by assessing the overall weather picture, types of cloud cover, thickness of cloud cover, and vertical temperature gradient in clouds. On the basis of these data one can only approximately determine the phase state and structure of cloud particles. This makes it possible to determine with a fair degree of reliability the presence or absence of icing conditions and to make a highly approximate estimate of icing intensity.

Flight safety during icing conditions depends to a considerable degree on the crew's ability correctly to assess weather conditions and precisely to observe the rules and procedures for using anti-icing and deicing systems as specified in the aircraft operating manual. What measures should be taken?

During the period of preflight preparation, it is recommended that those areas and altitudes where icing is predicted be identified, so that on these route segments the crew is prepared promptly to switch on the POS. Particular attention should be focused on zones of predicted icing where the air temperature is below the minimum value specified in the operating manual of the aircraft in question. If indications of icing appear on these route segments, the pilot should descend to an altitude with a higher outside air temperature or should proceed out of the icing zone.

Switching on anti-icing and deicing systems in a prompt and timely manner is an essential, mandatory condition for ensuring flight safety during icing conditions. We shall mention the general operating rules and procedures. More detailed recommendations can be found in the fixed-wing or rotary-wing aircraft operating manual.

POS of air intake ducts, propellers and spinners should be switched on when the OAT is +5 degrees C and below, regardless of whether or not the forecast includes icing conditions. When there is delay in switching on the POS, after icing has commenced, pieces of detached ice may enter the engine and cause damage or engine failure.

Pitot heat should be switched on at an OAT of +5 degrees or lower on the ground or, in the air, prior to entering clouds at any OAT.

The wing POS should be switched on during a flight when signs of icing occur. If a flight is taking place with OAT above -10 degrees C, the POS should be switched off periodically, and each time the system is switched on, one should check to determine how completely ice has been removed. The system should run continuously at OAT below -10 degrees C.

The tail POS should be switched on during precipitation when the OAT is at +5 degrees C or lower immediately after takeoff. During flight it should be switched on prior to entering clouds when OAT is below freezing.

When operating a helicopter main and tail rotor POS, one should bear in mind that switching on the system after icing commences can result in mechanical damage and engine failure caused by pieces of ice being slung off the blades.

In conclusion we should note that, although anti-icing and deicing systems are sufficiently effective, one should avoid extended flight in icing conditions.

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U.S. POLICY OF MAINTAINING BASES ABROAD CONDEMNED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 30-31

[Article, published under the heading "Imperialism -- Enemy of Peoples," by Candidate of Historical Sciences Col S. Zenin: "Military Basing Policy of the 'Neoglobalists'"]

[Text] The military force on which the United States is counting for preserving the status quo, defending the interests of the monopolies and the military-industrial complex, and preventing further progressive reforms in liberated countries can only complicate the situation and give rise to new conflicts. Money sacks can turn into powder kegs.

From the Proceedings of the 27th CPSU Congress

The world situation continues to be complex and dangerous, through the fault of the "neoglobalists" in Washington. In their attempt to achieve world domination, the most reactionary U.S. circles arbitrarily and openly state that a given region of the world falls within the sphere of their "vital interests," especially if it is rich in energy resources, is important from the standpoint of lines of communication, or if the Pentagon has simply "taken a fancy" to it. And the United States attempts to deprive the peoples living there of the right to control their own affairs and resources. The hegemonists in Washington also draw other nations into their military adventures and are enmeshing the world in a spiderweb of military bases, including air bases.

U.S. military air bases are situated at the most important strategic points throughout the world, enveloping the Soviet Union and the nations of the socialist community with gigantic arcs, as it were. The strategists across the Atlantic intend that these bases be an important supporting factor in implementing a policy "from a position of strength" and a guarantee of successful prosecution of "minor" nuclear wars and a "major" nuclear war.

Buildup by U.S. imperialism of its military presence in zones of the national liberation movement has become one of the principal vehicles of

"neoglobalism," which essentially is a pseudonym of neocolonialism and in this sense is directed primarily against the developing countries.

U.S. air bases, just as other military installations located on foreign soil, exert a destabilizing influence on the military-political situation in various regions and create new and dangerous focal points for the outbreak of local wars and conflicts in Asia, Africa, and Latin America.

The United States maintains bases and various military installations on the territory of dozens of countries. More than half a million U.S. military personnel are permanently stationed at these facilities. The Air Force operates more than 55 major air bases. U.S. Air Force installations include not only air bases but also garrisons, nuclear, chemical and other weapons depots, combat equipment and munitions storage facilities, aerospace surveillance posts, electronic intelligence centers, and other facilities of various function.

The U.S. policy on military bases is directly linked with Washington's foreign policy and with international politics as a whole. On the collapse of the Shah's regime in Iran, for example, when the United States was no longer able to use that country's military installations, the Pentagon immediately proceeded to establish fixed bases for the Air Force as well as other bases of operations in the Indian Ocean region. They proceeded with a presumed probability of their use not only on a regional scale but also for accomplishing tasks which are global in nature.

What is the reason for Washington's heightened interest in this region? First and foremost the fact that it is one of the focal areas of the bitter struggle between the forces of imperialism and the young developing countries of East Africa, Southwest and Southeast Asia. The overwhelming majority of these countries are committed to the goal of an atmosphere of peaceful cooperation and good-neighbor relations prevailing in the Indian Ocean region. Diametrically opposed to these interests are the expansionist schemes of international imperialism, U.S. imperialism in particular, predominant in the policies of which are considerations of a military-strategic nature: to gain military superiority over the USSR and the other socialist countries and to gain maximum favorable conditions for itself in case of initiation of aggression against revolutionary forces and the national liberation movement.

The great attention devoted by the United States to the Indian Ocean region also is connected with the interests of the big U.S. industrial and banking monopolies, which are exploiting this region's natural wealth and manpower resources. This region, for example, accounts for more than 70 percent of world production of natural rubber, 80.7 percent of gold, 56.6 percent of tin, and 32.5 percent of crude oil.

Major international sea-lanes cross the Indian Ocean. U.S. Air Force authorities in this region have expressed themselves quite plainly in this regard: "95 percent of the crude oil produced in the Persian Gulf area passes through the Indian Ocean. To interrupt this flow of oil even for a brief time means gaining considerable political preponderance."

Approximately 20 of 40 categories of strategic raw materials imported by the United States also originate in the Indian Ocean basin. The size of direct U.S. capital investment, exceeding 10 billion dollars, also serves as an important indicator of U.S. expansion in this region.

We must emphasize, however, that in the opinion of imperialist circles, in present-day conditions the Indian Ocean region presents the greatest value as a military-strategic region and war zone. Upgrading and up-arming of the air base on the island of Diego Garcia have been carried out toward this end. The United States is aware of the advantageous geographic position of this island, located in the middle of the Indian Ocean. This provides the Pentagon with the capability to use B-52 and B-1B strategic bombers to strike not only the countries of the Near and Middle East, Africa and Asia, but also the southern areas of the Soviet Union. The Pentagon believes that bombers and C-5 and C-141 heavy transport aircraft will be able to deliver strikes, troops, arms and equipment to "rapid deployment forces" in a prompt and timely manner for the conduct of combat operations.

This air base has given the United States the capability substantially to reduce Air Force "reaction" time to situation changes in the Persian Gulf and neighboring regions which are unfavorable to Washington. In the past, for example, several days were required to redeploy a fighter squadron from the United States to this region, while today, using this air base, it takes only a few hours. In the Pentagon's view, however, the one air base on the island of Diego Garcia is unable to perform many strategic and tactical missions connected with redeployment of interventionist forces to this region to "protect vital U.S. interests," since it is too remotely situated from "hot spots" in the Persian Gulf area.

For this reason employment of an arrangement to "lease" air bases in developing countries is a characteristic feature of the present military-base strategy of U.S. imperialism. U.S. Defense Department strategists are of the opinion that there is no need to raise the American flag at all bases. The main thing is to preposition equipment and establish stockpiles of arms to equip "rapid deployment forces." This allegedly will make U.S. expansionist aims less obvious and make it possible temporarily to deceive public opinion.

This new approach by the U.S. imperialists in the 1980's has given them access to many air bases on foreign soil. Several years ago, for example, following lengthy bargaining, the United States signed an agreement with Somalia permitting the U.S. Air Force to use airfields at Mogadishu and Berbera. "Access to Berbera," stated the NEW YORK TIMES, "would enable the United States to support aircraft and warships in the Red Sea and Arabian Sea, in the Gulf of Aden and the Persian Gulf, and in the Indian Ocean."

For several years now the United States has been using as an air base the island of Masirah, situated on the avenues of approach to the Persian Gulf. Facilities permit operating U.S. Air Force aircraft of all types out of this base. In addition, Oman has made airfields in several of its provinces available to the U.S. Air Force, including fields in the immediate vicinity of the border with the People's Democratic Republic of Yemen.

Saudi Arabia, which is pro-American and the largest country in the region, has not yet offered use of its territory for U.S. air bases. By acquiring aircraft armament, however, which is serviced by a large number of U.S. military specialist personnel, it is tacitly encouraging the establishment of U.S. Air Force bases in the region.

Since we are discussing U.S. air bases located on the territory of countries following in the wake of U.S. policy, we should also mention another form of expansion of U.S. imperialism -- the trade in arms and aircraft in the guise of so-called assistance. In exchange for such goods, pro-American regimes as a rule permit the construction of military installations on their soil. Trade in military aircraft and aircraft armament is viewed in Washington as an important channel for penetrating countries of interest. The objective is not only to place hundreds and even thousands of U.S. military aviation specialists in a given country but also to form in the target country a kind of pro-American "fifth column" made up of host-country flight personnel, technicians, and other specialist personnel who have received training in the United States.

U.S. military and political leaders believe that supplying modern aircraft to developing countries, especially in the Indian Ocean region, helps accomplish strategic concentration along the southern border of the Soviet Union and other socialist countries of aircraft which in a crisis situation could be used by U.S. Air Force personnel hastily airlifted from the continental United States.

In his study entitled "A Global Arms Trade Policy," U.S. specialist E. Pierre, defining the role assigned by the Reagan Administration in its foreign policy to trade in arms, stresses: "The arms trade has become an important component of the U.S. Government's approach to rivalry with the Soviet Union on a global basis, perhaps the most important instrument for actions abroad, not counting direct employment of U.S. military forces." This is indicated by the fact that each year sales and outright grants of U.S. arms by the Reagan Administration abroad have been increasing, in the opinion of experts, by 2-3 billion dollars from the 1983 level, when the United States exported 20.7 billion dollars worth of arms.

Thus the presence of U.S. military installations on foreign soil, particularly in the Indian Ocean region, is leading to a sharp escalation of the danger of war, is adversely affecting international relations, and is creating a threat to the socialist countries, the national liberation movement, and the vital interests of the developing countries. U.S. air bases situated on foreign soil and the presence of aircraft and military personnel on foreign soil in peacetime encourage U.S. reactionary expansionist circles to engage in risky ventures. These circles seek to resolve international disputes not by negotiation but by military blackmail and aggression.

On the other hand, by offering use of their territory, foreign countries, especially small countries, are virtually permitting the imperialists to determine their destiny and to determine such an important issue as war and peace. Usually they are unable to control or even limit the deployment of interventionist air forces and arms at these air bases. This means that at

any time they could be drawn into military actions of other, third countries, contrary to their own national interests. This applies particularly to countries in which Washington and the Pentagon have deployed or are planning to deploy nuclear weapons, allegedly creating a "nuclear umbrella," while in actual fact subjecting them to considerable danger.

In spite of all efforts, however, imperialism is unable to halt or alter the advance of world history. It was emphasized at the 27th CPSU Congress and at the June (1986) CPSU Central Committee Plenum that U.S. ruling circles are clearly losing their sense of realism during this complex period in history. Aggressive international conduct, growing militarization of policy and thinking, and disregard of the interests of other countries and peoples are inevitably leading to the moral and political isolation of U.S. imperialism.

3024
CSO: 9144/039

USING PROGRAMMABLE ELECTRONIC CALCULATORS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 34-37

[Article, published under the heading "The Pilot and the Computer," by Cols A. Andreyev and V. Rubin: "Structure and Keyboard Input Procedures of Programmable Microcalculators"; third article in a series, see Nos 7, 8, 1986]

[Text] In solving many applied military problems it is frequently necessary to perform a series of similar repetitive calculations with changing input data. An electronic hand calculator which can store a problem-solving program is effective in such instances.

The BZ-34, MK-54, MK-56, and MK-61 are programmable microcalculators (PMK) (Figure 1). They operate both in normal direct calculation mode and in automatic calculation mode, according to a program entered in advance.

Following are the principal components of a PMK: input/output device (UVV), processor, which includes an arithmetic and logic unit (ALU) and a control unit (UU), as well as memory (Figure 2).

The input/output device, just as in sliderule calculators, consists of a keypad, which combines input, output, and control functions. Commands from the keypad are executed by the control unit: operations are performed on the contents of memory. The latter consists of application-program RAM (PRP) with address counter and memory registers, which can perform the function of random-access memory (RAM), and read-only memory (ROM). Five stack registers in the processor are used as so-called high-speed memory in the PMK.

Application-program RAM contains a fixed number of memory locations for storing both operator codes and program operands. Regardless of a PMK's design, a "ring with memory locations" controlled by an instructions counter can serve as a physical model. In programming mode, when entering information this ring turns one step, the input information code is stored at the next memory location, and the contents of the instructions counter increments by 1.

The address stack consists of five registers used to store the instruction address to which control is to be transferred upon completion of a subroutine. It comprises a magazine-type stack of subroutines. The number of registers in

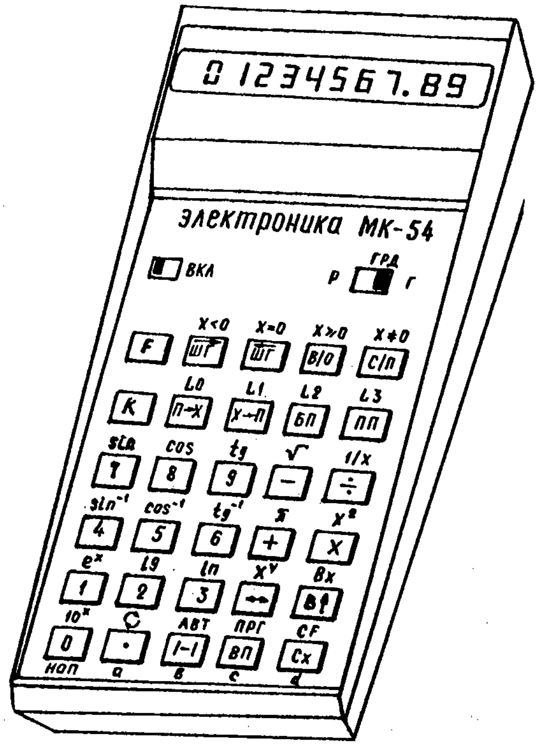


Figure 1.

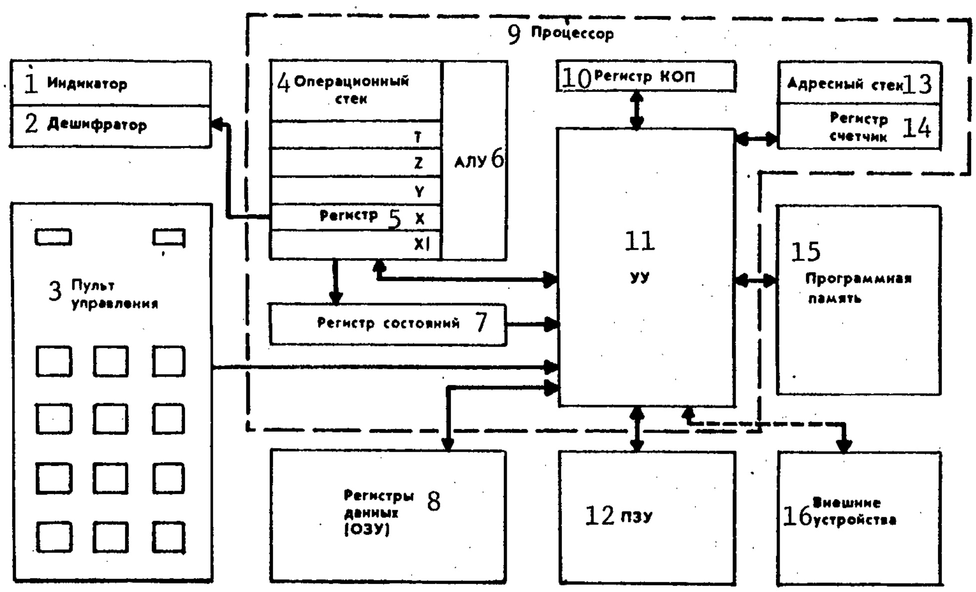


Figure 2.

Key: 1. Display; 2. Decoder; 3. Keypad; 4. stack; 5. Register; 6. ALU; 7. Internal-function register; 8. Memory registers (RAM); 9. Processor; 10. Operation code register; 11. Control unit; 12. ROM; 13. Address stack; 14. Counter; 15. Application program RAM; 16. Peripherals

this stack determines the number of possible calls to subroutines from the master program.

Data registers, just as addressable memory registers in sliderule microcalculators, are used for entering and storing numeric information. There are 14 of these in the BZ-34, MK-54, and MK-56, and 15 in the MK-61, which is the maximum number of random-access memory (RAM) memory locations in these PMK.

Read-only memory (ROM) holds the computation routines of the built-in functions. These routines cannot be changed; they can only be called, and results obtained. Just as in sliderule microcalculators, ROM routines calculate the values of the functions indicated on the calculator keypad.

The processor executes the instructions of a computation routine built into the calculator. It includes a control unit (CU), internal-function register, and arithmetic and logic unit (ALU), which operates together with a stack containing five registers: X1, X, Y, Z, and T. The numbers (operands) in the stack are moved from register to register either by keypad commands or automatically during program execution. We shall discuss movement of information in the stack later. At this point we shall note that, just like sliderule microcalculators, two registers are particularly important for a PMK: the X and Y registers. Wroking together with the X register, the arithmetic and logic unit performs single-number operations, and two-number operations with the X and Y registers. The result of any operation is stored in the X register which, just as in nonprogrammable microcalculators, is connected to the display. Completion of execution of an ALU operation is recorded in the internal-function register.

And, finally, the control unit organizes combined operation by all units in the PMK and, most important, operation of the ALU.

We shall now examine PMK keyboard input procedures. Information is entered into the PMK and operating mode specified with the keypad, each key of which is designated to perform not more than three operations. The F and K keys (prefix operator-modifiers) do not perform an independent function but serve to reduce the total number of keys. Each command, regardless of the number of keys pressed (as many as three for some commands, such as K, IP, and I) is displayed in the appropriate code, which comprises either a two-digit number or a number with a special symbolic character (G, L, -, E, etc).

The procedures of entering numbers into a PMK are the same as for the MK-41 nonprogrammable microcalculator. Let us recall the basic procedures. To enter a number in exponential form A x 10 to the b power, where A is the mantissa and b is the exponent, after entering the mantissa press the VP (enter exponent) key. Two zeroes will appear in the right-hand portion of the display. Then the number keys can be used to enter the desired power of the number, the maximum value of which is 99.

The "/-/" key is used to enter negative numbers. It should be pressed after entering all digits of the mantissa. The symbol /-/, entered after pressing

the VP key, reverses the sign of the exponent but not of the number. An incorrect entry is erased witht the Cx key.

The input statement procedures used on a type MK-54 and similar programmable microcalculators employ inverse notation, or inverse syntax without parentheses. This is indicated by the "B up arrow" key.

The MK-54 can calculate 14 functions, such as square root, square, and others indicated on the keypad. These functions are called with the F prefix key and the key above which the desired function is marked. The MK-61 can also extract the whole part of a number, determine its absolute value, and perform other functions by first pressing the K prefix key.

Use of the various functions will be demonstrated by solving specific problems. We shall merely note that the argument for each of them is taken from the X register, where the result is also stored. For this reason such calculations, just as in nonprogrammable microcalculators, are called single-number calculations.

For example, to obtain the square root of 5, the key sequence is as follows: 5, F, square root. The result -- 2.2360679 -- is stored in the X register and is displayed. The function argument is stored in preceding result register XI. The contents of the other registers in the stack remain unchanged.

Figure 3 shows shifting of numbers in the stack: register contents are shown in the vertical columns, and horizontally -- executed single-number operation as a result of which the given stack contents were formed.

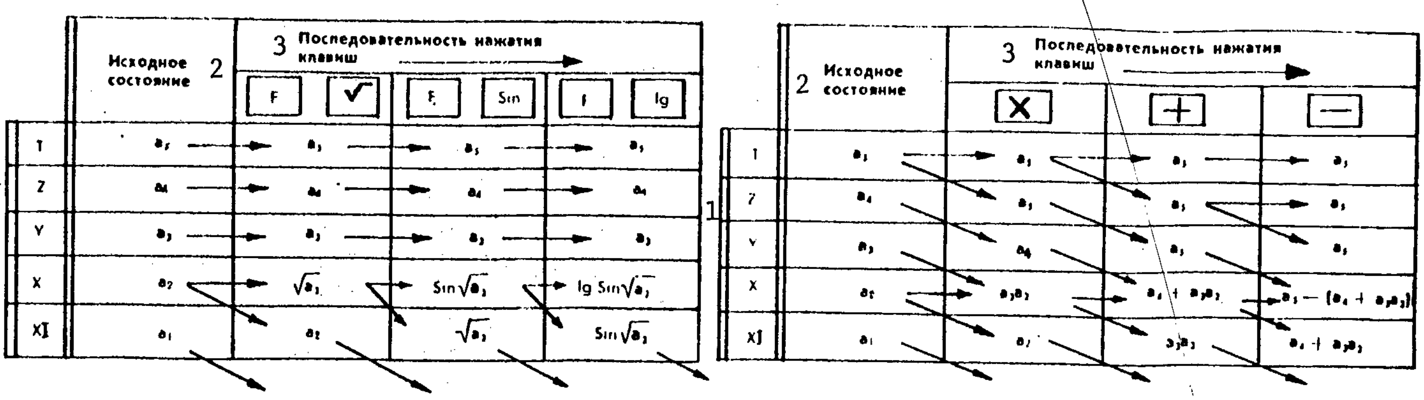
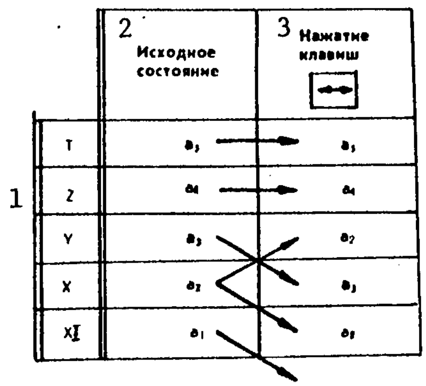


Figure 3 and 4

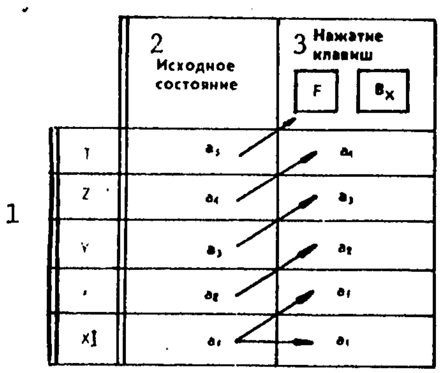
Key: 1. Stack registers; 2. Initial state; 3. Key sequence

Two-number (arithmetic) operations are performed on the MK-54, just as on conventional microcalculators, with the X and Y registers. For example, to multiply the two numbers 5 and 3, for a programmable microcalculator with inverse notation the sequence of procedures should be as follows: enter the number 5, then 3, and perform multiplication.



Figures 5 and 6

Key: see Key to Figures 3 and 4



Figures 7 and 8

Key: see Key to Figures 3 and 4

After entering the number 5, however, the calculator "will not know" whether number entry has been completed. One must indicate by pressing the "B up arrow" key that number entry is completed and that the number is to be copied to the Y register, while also remaining in the X register. After the number 3 is placed in the X register, the microcalculator is ready to perform multiplication. The key sequence is as follows: 5, B up arrow, 3, X. As we see, pressing the X [multiply] key indicates that entry of the number 3 is completed and multiplication is to commence. We should note that the multiplication result (the number 15) was placed in the X register, while the number that had been in this register (3) was moved to the XI register. This is a very important feature of the register stack of a programmable microcalculator.

Another very important element is associated with performance of operations on two numbers, an element which is called "dropping information in the stack." Essentially as a result of a two-number operation on the contents of the X and Y registers, the obtained result is moved to the X register, and the contents of the Z register "drop" into the Y register in place of the second operand, while the number from the T register is transferred into the Z register, with the number which has been moved into the Z register remaining in the T register, and the XI register will contain the number which was previously in the X register. Figure 4 shows information movement in the stack during sequential execution of operations with two numbers.

Following is the principal rule in performing arithmetic operations: the dividend and minuend are in the Y register, while the divisor and the subtrahend are in the X register. Therefore it is necessary always to know the location of the operands in the corresponding registers. This is particularly important in writing programs, since during program execution the operands are subsumed for executing an operation automatically and it is virtually impossible to display the result.

If in the calculation process the dividend (minuend) is in the X register and the divisor (subtrahend) is in the Y register, one can exchange their contents by using the <-> operator. During execution of this operator the number in the X register is copied to the XI register. That which was in other registers remains unchanged (Figure 5). The operation exchanging the contents of the X and Y registers plays an important role both during simple calculations and during automatic calculation by program.

When necessary, upward shifting of numbers in the stack is achieved with two operations, the first of which is performed with the familiar "B up arrow" key and the second with the F and Bx keys. When the up arrow operator is entered, the contents of the XI register remain unchanged, but after pressing the "B up arrow" key moves up the stack from the X register, leaving a copy in each register it has passed. Naturally numbers from the T register "drop out and are lost" thereby, as is evident in Figure 6.

The Fbx operator acts similarly to the up arrow operator. The difference lies in the fact that the contents of the XI register are moved into the X register, that is, stack contents move up (Figure 7). This operation can be utilized with effect both to check the contents of the XI register in single-number operations and with various calculations.

We shall now examine the rotate operation executed by pressing the F and rotate keys. When the rotate operator is entered, the stack operates in rotate mode: the contents of the XI register are moved to the T register, while information contained in the T, Z, Y, and X registers is pushed down into the next-lower register (Figure 8).

Rotation is used to store in RAM the result of any operation and for transferring numbers from the XI and Y registers into the X and Y registers to perform operations on them. Thus numbers move through the stack registers in response to calculation operation instructions and information exchange instructions.

We should note that information exchange instructions, in addition to those enumerated above, include instructions to move the contents of the X register into one of the addressable registers (memory registers) and vice versa. In the MK-54 addressable registers are designated by the numbers 0-9 and by the letters a, b, c, d. (The MK-61 contains an additional register designated by the letter e).

In programmable microcalculator interactive mode, addressable registers, just as with the MK-41, are fully under the operator's control. In program mode, however, movement of numbers into registers, calling and shifting of numbers are accomplished by program, that is, automatically, following program instructions. It is precisely this which makes programmable microcalculators fundamentally different from sliderule microcalculators.

Information is moved from the X register into one of the memory registers by pressing the X->P and N keys, where N is one of 14 registers. To fetch a number from a memory register into the X register, press the P->X and N keys.

As regards storing numbers in programmable microcalculator addressable registers, they remain at memory locations until new numbers are written to those locations. The contents of all registers are erased when the calculator is switched off.

We should note that when a number is called from an addressable register it is moved into the X register. Numbers in stack memory move precisely as with entry of a new number. Rules of stack operation do not change, regardless of whether numbers are entered from the keypad or are brought from addressable registers.

In addition to operators used for interactive-mode calculations, programmable microcalculators have utility operators and program execution automatic control operators.

The group of utility operators includes shift to programming mode (F PRG) and shift from programming mode (F AVT) operators, as well as operators for editing an entered program: erroneously entered operation code (K NOP), program RAM step forward (-> ShG) and step backward (<-ShG), plus several others.

The group of control operators contains one of the principal stop/start operators (S/P). Pressing the S/P key starts a program running, while execution of this operator in program mode ends the program.

Conditional jump, jump, and certain other operators accomplish the required changes in sequence of execution of program operators. We shall note that the number of operators which a programmable microcalculator can handle is extremely large. We shall discuss this in greater detail in presenting methods of programming various problems. Since the input language of the Elektronika MK-54 is similar to those of type BZ-34, MK-56 and MK-61 programmable microcalculators, we shall henceforth call these microcalculators' input language the MK-54 input language. The table lists

differences in key designations for those persons who will be using other Soviet programmable microcalculators. It also lists the designations which will be used in the text of subsequent articles.

БЗ-34	МК-54, МК-56, МК-61	В тексте рубрики
ИП	П→Х	ИП
П	Х→П	П
(ХУ)	↔	↔
↑	В↑	↑
÷	÷	÷
⟲	⟲	FO
arcsin	$\sin^{-1}$	F arcsin
arccos	$\cos^{-1}$	F arccos
arctg	tg^{-1}	F arctg
А, В, С, Д	а, в, с, d, е	А, В, С, Д, Е

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differences in key designations for those persons who will be using other Soviet programmable microcalculators. It also lists the designations which will be used in the text of subsequent articles.

3024
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ENCOURAGING TECHNICAL INNOVATORS AT AIR FORCE SCHOOLS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 36-37

[Article, published under the heading "Know-How of the Best Into the Combat Arsenal," by Lt Col Yu. Georgiyev, senior engineer-inspector, Air Force Office of Inventions and Efficiency Innovation: "Developing Initiative"]

[Text] Scientific and technological advance, invention and efficiency innovation are of enormous social significance in present-day conditions. Involvement in creative activity has a beneficial effect on forming the spiritual/intellectual countenance of the Soviet citizen, develops a communist attitude toward labor, and instills a caring attitude toward socialist property. It was noted at a conference at the CPSU Central Committee on acceleration of scientific and technological advance that our country expects a great deal of our young people, their energy and inquiring minds, their interest toward everything new and progressive.

Our party is today setting for itself the task of enhancing the prestige of engineer labor and increasing its efficiency and effectiveness, for the social prestige of the specialist, as we know, is determined by his creative potential and a constant striving to create something new and advanced, something economically beneficial for our state and its Armed Forces.

An enormous role in this regard is played by Air Force higher military aviation engineering schools. It is precisely at these schools that a solid foundation is laid down for an innovative approach to practical utilization of acquired knowledge. In addition to excellent organizer abilities and methods skill, today's engineer should possess erudition and the skills of an innovator, ability and practical work experience.

In order for graduates of Air Force higher educational institutions, upon receiving their engineering diploma, to become rapidly and boldly involved in solving various problems pertaining to operation and maintenance of modern, complex aircraft and in resolving the important practical scientific and technical problems advanced at the 27th CPSU Congress, it is very important during the teaching and learning process to get them involved in technical innovation and aggressively to enlist them into military scientific and invention activity. Favorable conditions have been created for this at Air

Force military educational institutions. Purposeful invention and efficiency innovation activities promote the involvement of personnel enrolled at aircraft schools and academies in active technical creative endeavors.

We should note that during the years of the 11th Five-Year Plan innovators at the military air academies and higher engineering schools are credited with a total of more than 22,000 efficiency innovation proposals and the submission of 1960 invention applications.

Today the effectiveness of technical creative endeavor by Air Force innovators in accomplishing important current tasks depends on the degree of purposefulness of their activities in those areas of priority emphasis specified in the appropriate documents of the Commander in Chief of the Air Forces and on invention and efficiency innovation activity topic lists.

The subject matter is of current importance and is extremely broad. Efficiency innovators improve existing aircraft assemblies and components, servicing, maintenance, and repair processes, solve problems of equipping new and renovating existing training facilities, design and build various means of mechanization and automation. By their labor they help economize in material and financial resources and promote increased labor productivity. This has a substantial effect on increasing Air Forces combat readiness.

As the CPSU Central Committee has pointed out time and again, further improvement in collective forms of creative endeavor, broad dissemination of advanced know-how, and well-conceived organization of socialist competition to achieve stated goals in each and every collective, at each and every work station constitute an important reserve potential for speeding up scientific and technological advance. Student design offices (KSKB) have become one such form of scientific and technical creative endeavor at Air Force military educational institutions.

Design offices at Air Force higher educational institutions have always achieved substantial results, from the very first phase of participation in the review of KSKB activities at military educational institutions of the USSR Ministry of Defense. Each year the Air Forces deputy commander in chief for military educational institutions as well as the chief of the Air Force Office of Invention and Efficiency Innovation conduct training courses for KSKB leader personnel at the facilities of one of the military educational institutions, at which they also total up the year's performance results by efficiency innovators. At these get-togethers KSKB supervisors become acquainted with unique and interesting suggestions, exchange work experience and know-how, and draw up specific measures to improve the effectiveness of technical creative endeavors by future Air Force engineers.

As a result there has been a recent substantial increase in work activity by innovators at military aviation schools. For example, on the basis of the results of the USSR Ministry of Defense review, the Riga Higher Military Aviation Engineering School imeni Yakov Alksnis was awarded a second prize in the amount of 700 rubles, the Kharkov Higher Military Aviation School of Electronics imeni Ukrainian Lenin Komsomol was awarded a third prize of 500 rubles, while the Vasilkov Military Aviation Technical School imeni 50th

Anniversary of Komsomol UkSSR was awarded an honorable mention cash prize, and the Kacha Higher Military School for Pilots imeni A. F. Myasnikov was awarded a Certificate of Merit of the Central Council of the All-Union Society of Inventors and Efficiency Innovators.

The KSKB are working with steadily increasing effectiveness. Last year, for example, there was an increase in the volume of work performed and in the total membership. Members submitted more than 3,000 efficiency innovation proposals, 2,600 items were built, most of which are actively being utilized in the training process, and 108 items were selected for display at the NTTM-85 exhibit.

The subject matter of the projects has also become more diversified. It is becoming more closely coordinated with course projects, senior projects, and scientific research projects.

Of course the organizational form and work methods differ in their specifics from one Air Force military educational institution to the next. But the main thing is that everything pursues a common objective: to develop and form in future aviation engineers solid skills in scientific and technical innovationism.

Matters pertaining to exchanging advanced know-how in invention and efficiency innovation activities occupy the center of attention of administrative authorities, party, trade union and Komsomol organizations, and invention boards. The best new innovations are discussed in informational publications and technical briefing sheets distributed to Air Force units and aircraft overhaul enterprises. Unfortunately, however, Air Force higher educational institutions rarely receive from the units response comments and announcements of adoption of innovations.

We should also note that technical creative endeavors by service school innovators have become an integral part of socialist competition for achieving the best results in training and innovation activities. For example, at a conference of inventors and efficiency innovators at the Kharkov Higher Military Aviation School, socialist pledges made in honor of the highest party forum specified submission of 38 invention applications and adoption of 400 efficiency proposals and 77 technical innovations. Thanks to a high degree of organization and a sense of responsibility for the success of the undertaking, this school's innovators substantially overfulfilled their pledges. They produced 62 technical solutions at the invention level and adopted 497 efficiency innovation proposals.

Efficiency innovation proposal selection and adoption months, reviews to determine best handling of invention and efficiency innovation activities between academy and service school subunits, competitions for the best solutions in improving training facilities, as well as other measures greatly promote the further development of student creative endeavors.

Academy and service school innovators took active part in the "For Mass Participation and High Effectiveness of Scientific and Technical Innovation" review-competition held by decision of the USSR Ministry of Defense. The

Kharkov Higher Military Aviation Engineering School was announced the first-phase winner of competition among Air Force military educational institutions. Its innovators submitted 81 applications for inventions, adopted 876 and devised 893 efficiency innovation proposals. A total of 25 technical innovations were borrowed from the Exhibit of Achievements of the USSR National Economy and adopted for improving the teaching and learning process. Innovators at the Military Air Engineering Academy imeni N. Ye. Zhukovskiy also achieved excellent results in the review.

Future aviation engineers give effective assistance to line units and aircraft repair and overhaul enterprises during their tour of duty in the line units and during practical field training. Last year alone they submitted more than 2,000 efficiency innovation proposals.

As we know, the results of any endeavor depend on how it is organized and guided toward accomplishment of specific practical tasks. Prior to departure for a tour of duty in a line unit or during practical field training, academies and service schools arrange for a briefing session for group leaders, at which efficiency innovation targets are assigned. In line units and at aircraft overhaul enterprises Air Force school students on a line-unit or practical field experience tour of duty maintain meaningful contact with aviation engineer service supervisory personnel and invention boards, who explain to the students the subject matter and tasks assigned to the innovators of a given military collective.

Student participation in efficiency innovation activities of military units is viewed by the administration of service schools as an important element in embodying obtained theoretical knowledge into practical activities. For example, a proposal by V. Melnikov, a student at the Riga Higher Military Aviation Engineering School imeni Ya. Alksnis, entitled "Device to Measure Turbine Bearing Radial Play," adopted at an aircraft overhaul enterprise, greatly facilitated quality inspection of assembly of aircraft engines during overhaul. A group of innovators at the Voronezh Higher Military Aviation Engineering School devised a means of predicting aviation-hazardous weather tailored to specific region. Sr Lt N. Zushchik, a student at the Kiev Higher Military Aviation Engineering School, designed and built a device to pump up aircraft tires from the emergency air pressurization system, which made it possible under field conditions to accomplish this without ground equipment.

Students at the Military Air Engineering Academy imeni N. Ye. Zhukovskiy have also come up with many unique and interesting innovations. Sr Lt V. Shishkin, for example, built an aircraft avionics simulator to accomplish more efficient and higher-quality training of Air Force unit and subunit engineer and technician personnel. And at the Kharkov Higher Military Aviation Engineering School cadet V. Pristupa and Lt S. Voznosimenko, under the guidance of officer V. Samoray, designed and built a device to perform automatic testing of an aircraft engine startup control system. This device made it possible to shorten engine startup cyclogram verification time to 5 minutes. The device was tested at an aircraft overhaul enterprise and displayed a high degree of reliability and measurement accuracy. An invention application for it has been submitted.

Active participation by innovators at Air Force military educational institutions in topic-area competitions is making it possible to accomplish important tasks pertaining to expanding the capabilities of aircraft and weapons and to improve servicing and maintenance methods. Eight Air Force schools took part just in four topic-area competitions on improving electronic equipment, with the submission of 26 projects, three of which were awarded a first prize, two a second prize, and three a third prize. Some were submitted to this country's chief exhibition -- the Exhibit of Achievements of the USSR National Economy.

Service school administrations, the Air Force Invention and Efficiency Innovation Office, command authorities, political agencies, party and Komsomol organizations at Air Force schools are taking all measures to ensure that the scientific and technical creative endeavors of future engineers undergo further development and become even more effective. Toward this end special lists of topics for inventors and efficiency innovators at Air Force schools for 1986-1990 have been drawn up, with principal attention focused on improving teaching, laboratory, and testing facilities and giving technical and practical assistance to line units and aircraft overhaul enterprises in accomplishing the difficult, critically important tasks assigned to the USSR Armed Forces by the 27th CPSU Congress.

3024
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WESTERN ADVANCES IN STEALTH TECHNOLOGY

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 38-41

[Article, published under the heading "Weapons of Aggression and Brigandage," by Candidates of Technical Sciences Lt Cols V. Yefimov and V. Antipov and Sr Lt V. Lepin: "'Stealth' in U.S. Military Plans"; based on materials published in the foreign press]

> [Text] The world political situation remains complex, and at present there are no grounds to claim any relaxation of tensions. This as the conclusion stated by Comrade M.S. Gorbachev in his speech at the June (1986) CPSU Central Committee Plenum summarizing the Budapest meeting of the Political Consultative Committee of Warsaw Pact member nations.
>
> The resolution passed on this issue stated, in particular, that the basis of the present international tension is the dangerous foreign policy and imperial ambitions of the United States, which seeks to ignore the will of peoples. The White House administration and the Pentagon are counting heavily on military aviation for achieving their aggressive aims. This was confirmed by U.S. military operations against the DRV and by the U.S. pirate attack on Libya in April 1986.
>
> It is no accident that the United States is constantly developing new aircraft and upgrading aircraft already in service. The "Stealth" project is a specific activity in this area which has been widely discussed in the Western press.

In order to gain military superiority over the USSR and the other nations of the socialist community, the leaders of the NATO imperialist bloc, and the United States in particular, are rushing to build up efforts in long-term weapons development. They are seeking to make maximum use of scientific and technological advances in military hardware.

The United States is presently engaged in the attempt to implement these schemes, which were difficult to embody in aircraft of preceding generations due to technical equipment deficiencies.

The aim of the Stealth project is to lessen the probability of detection -- by radar, infrared, visual, and other means -- of air targets such as aircraft, remote-piloted vehicles (RPVs), and cruise missiles. It is not possible fully to solve this difficult problem merely by modernizing and upgrading airborne EW gear, since modern radars employ more sophisticated moving target indication (MTI) systems, adaptive processors, and phased-array antennas. In addition, active employment of modern infrared radiation aircraft detection systems diminishes the effect of IR jamming and IR decoy flares.

Principal directions being taken to reduce so-called signature in the Stealth project include primarily reducing the radar cross section of the airframe, by diminishing the intensity of powerplant infrared radiation, by improving EW capabilities, etc.

Primary efforts are being made toward reducing (by a factor of 10-100) the radar cross section of such targets. As is noted by foreign observers, Stealth project engineers are aware that radar cross section is greatly affected by the shape of the airframe and the materials of which it is made, rather than by its physical dimensions.

At the beginning of the 1960's Lockheed and Ryan Aircraft proceeded with development of an aircraft the radar cross section of which was decreased solely by altering its shape (a lean profile, small stabilizer, etc) and using new nonmetallic materials. Positive results were achieved by Lockheed in development of the A-12 aircraft. But even after upgrading, it was easy to detect the A-12 at long range by the infrared radiation of its powerplant.

In efforts to decrease the radar cross section of RPVs, at the beginning of the 1960's Ryan began testing a modified reconnaissance drone. Lockheed was also successful in development of the expendable D-21 aircraft. It was to be launched by an A-12. By this time Ryan had developed the AGM-91 aircraft, details on which are still classified. Apparently development of the manufacturing technology used on the D-21 and AGM-91 was the basis for today's Stealth technology.

The first serious proposal made to Lockheed within the framework of the Stealth project was made by the U.S. Air Force. Intensive work on this project began in 1977. Recently it has received new impetus in connection with the fact that a reduced signature is to become an important characteristic of any promising future U.S. combat aircraft, determining its shape, size, and configuration.

Several designs based on the Stealth project were developed between 1979 and 1981. These will be the main directions taken up to 1990. They include building a demonstration model of the hard-to-detect CSIRS aircraft, construction of a B-1B bomber version incorporating Stealth technology, development of a new and promising ATB strategic bomber, fully incorporating the requirements of the Stealth program, development of an improved version of the second-generation ACM supersonic air-launched cruise missile incorporating Stealth technology (replacing the subsonic ALCM), as well as construction of the promising ATF reduced-signature tactical fighter.

A number of sources offer some information on the shape of and materials used in future aircraft to be built by Lockheed. One should, however, bear in mind the advertising publicity nature of this information and an attempt to claim as achieved that which has not yet been attained. Foreign military experts believe that reduction of signature will be achieved by employing in the airframe design solutions, components and special coatings capable of absorbing radar signals in the 5.2-10.9 gigahertz band, by employing future EW systems which spoof the enemy's sensors, as well as by employing offensive weapon systems. They claim that in 1982 Lockheed received a contract for series (but in small numbers) production of the CSIRS so-called enhanced-survivability stealthy all-weather reconnaissance-strike aircraft.

Although it is desiganted a "fighter," its principal mission is not to gain air superiority but to conduct long-range reconnaissance prior to sealing off the battlefield and clearing corridors of air defense fighters in order to create favorable conditions for operations by F-15, F-16, and F-111 fighter-bombers and B-1B and ATB bombers. It is reported in foreign sources that this aircraft will be able to carry a mixed payload consisting, for example, of air-to-air missiles, air-to-surface missiles, and glide bombs. It will also be equipped with modern avionics and EW systems. It is also reported that the aircraft is fitted with an LPIR multimode low-detectability radar with a flat antenna array, capable of tracking air targets during passage and determining the location of such ground targets as enemy antiaircraft missile systems and radars. According to some sources the aircraft may be equipped with a bistatic radar, which will enable such aircraft as E-3A AWACS aircraft to patrol in the immediate vicinity of the enemy's dispositions in order to detect and track air targets and transmit information to a low-signature aircraft, thus ensuring its inconspicuousness. In addition the aircraft extensively employs passive optoelectronic sensors, which do not generate a signature, in combination with EW gear.

Foreign experts stress that the aircraft's configuration will be that of a "double triangle" (wing in the form of two triangles placed one on the other), which in planform is reminiscent of the configuration of the L-2000SST supersonic transport, while its size is approximately the same as the F-4 Phantom or F-18 Hornet. The air intake and engines are positioned above the fuselage, and the exhaust nozzles are located between two inward-canted stabilizers.

The CSIRS aircraft is powered by two F-404-GE400 engines and can reach a speed in excess of Mach 2.5, boasts a ceiling of about 18,300 meters, and a range of approximately 960 km. It is presumed that the CSIRS will be a single-seater, but according to some sources a two-seat version will be built, in view of the complexity of operating the EW system and high-intensity crew working conditions during combat employment.

In implementing the Stealth technology, certain changes were also made in the design of the B-1B bomber in order to reduce its radar cross section and diminish detection effectiveness by ground air defense radars. For example, by curving the air intake ducts and placing inclined radar-absorbing baffles in them, they cannot be directly illuminated by hostile radars. Attenuation

of the reflected signal is also accomplished by absorbing part of its electromagnetic energy with special closed-coil windings placed under the skin of access covers fabricated of composite materials as well as in some structural member joint seams. For this same reason the bomb bay doors, the leading edge of the root section of the wing and forward edge of the engine air intakes are coated with materials possessing radar-absorbing properties. The forward-scanning phased-array radar in the nose is mounted at a permanent downward angle of 35 degrees. This reduces the level of forward-reflected hostile radar signals. Measures have also been taken to accomplish an overall improvement in streamlining of the airframe, sharp edges and right angles have been eliminated at skin panel curvature points, transitions from one surface to another have become smoother, and sharp-pointed projections have been eliminated. The U.S. press claims that the radar cross section of the B-1B bomber is equivalent to 1 square meter due to the above-enumerated measures.

Information about the Northrop ATB advanced technology bomber first appeared in the press in 1984. It is believed that it will be reminiscent of the YB-49 "flying wing" of the 1940's. Its maiden flight is scheduled for the end of next year. Reports on the aircraft's dimensions are contradictory at present. A takeoff weight of about 180 tons has been mentioned, and a wingspan the same as that of the YB-49. It will be powered by four F-404 engines. An analysis has confirmed, however, that these engines are patently inadequate in power to perform the combat missions assigned to the crew of a strategic bomber with a takeoff weight of 180 tons. There are also reports that its physical dimensions are considerably in excess of the original figures.

Stealth technology is also presently being extensively employed in building and upgrading the ALCM (AGM-86B) and ACM air-launched cruise missiles. Their development reflects an endeavor on the part of aggressive U.S. reactionary circles to possess reliable and inexpensive weapons which can penetrate increasingly more sophisticated air defense systems, while using a small radar cross section, improved engines and guidance system makes it possible to build large numbers of weapons which are difficult to detect and destroy. The relatively low cost and high survivability of cruise missiles has broadened the range of their utilization for purposes of aggression as more expedient and effective than other weapons when evaluated according to the criterion of cost and combat capability. The ACM cruise missile, for example, is second-generation and will differ from its predecessor, the AGM-86B, not only by greater range (up to 4,200 km) but also accuracy of delivery of warhead to the target, as well as extensive employment of Stealth technology. Powering the missile with fundamentally new engines and composite materials (carbon-fabric-reinforced composite, ceramic coatings, etc) will evidently make it possible on the one hand to reduce the missile's radar cross section and on the other to increase its range by reducing weight. Adoption of radar-absorbing coatings and substantial changes in the shape of air intakes, as well as decrease in exhaust gas temperature and noise reduction on the ACM cruise missile will make it possible appreciably to decrease its radar cross section in comparison with AGM-86B cruise missiles.

Capability of undetected flight in present-day conditions plays a very important role in U.S. aggressive plans to develop the future ATF tactical

fighter, which is also persuasively confirmed by the barbaric operation mounted by the U.S. Air Force against Libya in April of this year.

According to existing plans, the ATF is to replace the F-15 fighter in the air superiority role and in intercepting enemy aircraft primarily at long range, especially beyond the battle line. In the opinion of the head of the ATF development program, it must meet three clearly-defined functional requirements: it must successfully penetrate a hostile air defense system, engage enemy aircraft at a distance substantially beyond visual range, and also conduct close-in air-to-air combat. In the United States it is believed that the ATF should not only surpass the potential adversary's best aircraft in performance characteristics but also be capable of flying several combat sorties a day.

In the opinion of foreign military experts, the ATF will be able to cruise supersonic at high altitude, will be highly maneuverable as supersonic speed, will have a low signature by incorporating Stealth technology, in order to increase capability to carry out a combat mission with impunity, high-capability electronics capable of ensuring detection and intercept of air targets located at considerable range, as well as STOL capability.

According to reports in the foreign press, the U.S. Air Force would like to have in service an aircraft which can maneuver effectively at speeds of M=0.9 at an altitude of 3,050 meters at 9 Gs and in cruise at a speed of M=1.5 at an altitude of 15,240 meters at a sustained load of 2 Gs. The aircraft will weigh approximately 22,700 kg. It will have vectored thrust and thrust reversal capability, which will enable it to take off from or land on a runway 610 meters long. The principal armament of the ATF will be the AMRAAM medium-range air-to-air missile.

Although structural design of the ATF (employing 50 percent composite materials and boasting a low signature) is considered fairly important, paramount importance is attached to development of an integrated airborne electronics package.

According to statements made by spokesmen for foreign companies, the main problem is that of meeting requirements which call simultaneously for excellent performance characteristics and low probability of detection by hostile radar. It is therefore not surprising that principal attention was focused on this at the initial stages of the program. Primary consideration was given to such parameters as radar cross section (efforts are being made to reduce radar cross section to 0.1 square meter), infrared signature, as well as radio-frequency emissions and noise. It became obvious, however, that in many instances low probability of aircraft detection is achieved at the expense of performance. For this reason the Air Force proposed reducing requirements on undetectability of the ATF in order to increase its speed, range, maneuverability, and improve other performance characteristics.

The accompanying photographs [not reproduced] contain sketches of aircraft being developed by Boeing and Rockwell incorporating Stealth technology.

As foreign observers point out, the West German firm of Dornier is working on designing a future low-signature ground-attack aircraft. It is inclined toward a "flying wing" design incorporating a triangular planform of low aspect ratio and high leading-edge sweep angle, which makes it possible maximally to increase the size of the internal weapons bay while ensuring a very small radar cross section. The weapons bay of the aircraft in question is 5.5 meters in length and 0.75 meter in height and will be able to accommodate two guided missiles, which would be launched at a standoff distance beyond range of hostile air defense, or a single munitions dispenser with an MW-1 cluster bomb unit, in place of four AGM-65 Maverick missiles or six BL-755 bombs.

It is believed abroad that practical incorporation of Stealth technology, which enables aircraft and cruise missiles to fly undetected, will exert considerable influence on future airborne electronics packages and on subsequent evolution of the combat tactics of future aircraft of the NATO bloc countries, particularly the United States. They are projecting, for example, more extensive use of millimeter-band passive infrared and radio-frequency sensors, as well as employment of radars operating in on-off mode, in order not to reduce to a minimum the advantages of the Stealth technology due to extended radar emissions.

As foreign observers note, as a consequence of traditional limitations on airborne radar transmitter power and antenna size, one should not count solely on increasing antenna size to achieve the required target detection range with reduced radar cross section. One version of solution to this problem will involve employing promising methods and means of processing signal fields reflected back from the target.

In July 1986 the supersecret F-19 fighter, incorporating Stealth technology, streaked across California's night sky like a fiery comet. This aircraft was supposed to be invisible to air defense. The miracle failed to come to pass, however. The fighter crashed and was destroyed during a test flight.

Implementation of plans to build weapons of aggression and brigandage employing Stealth technology constitutes one more confirmation of the aggressive policy of the present U.S. administration, which is endeavoring by means of steady buildup of offensive weaponry to alter is own favor the objectively existing military-strategic balance. Further escalation of the arms race, however, is not only having a negative effect on the world military-political situation, but may make it impossible to resolve the very important, crucial problem of reducing nuclear missiles and other arms. In addition, such a development of events will inevitably result in diminished security both for the United States itself and for its allies.

3024
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Mi-24 SECTION MAINTENANCE CHIEF SERVES IN AFGHANISTAN

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 40-41

[Article, published under the heading "Marching in the Vanguard," by S. Lisitskiy, member of the USSR Union of Writers: "On the Wings of A Dream"]

[Text] Sr Lt Oleg Nikiforov, speaking softly, told me: "My father is a very deliberative and serious man. He will think through a matter very thoroughly before making a decision. He likes order in all things. He demands that one keep one's word. A quality he appreciates is willingness to help."

Yuriy Pavlovich Nikiforov, graduating from the Riga Higher Military Aviation Engineering School imeni Ya. Alksnis, began his military service in the Leningrad Military District. He was subsequently stationed on Sakhalin. After his tour of duty in the Far East he was transferred to the Ukraine. After that he was again assigned to Leningrad Military District air forces. Yu. Nikiforov is a lieutenant colonel in the reserve. He has not bidden farewell to aviation, however. He is on the staff of the Riga Institute of the Ministry of Civil Aviation, an engineer in the scientific research division.

His father's career involved considerable moving about, as well as certain hardships, and Oleg became accustomed from childhood to the military life. Just like most of the boys living on the military post, after arriving home from school he would hurry over to the airfield for a close-up view of the fighters taking off and making their departure climbout. He loved to listen to the roar of the turbines and to breathe in the exciting aroma of hot metal and turbine exhaust.

Oleg was familiar with almost all the fixed-wing and rotary-wing aircraft and could distinguish them by type and category. He could identify a helicopter not only by configuration but also with his eyes closed by the sound of its engines. And the better he became acquainted with the flying life, the more attached he became to his father and the latter's fellow servicemen. The notion that aviation "is supported on three whales" entered his consciousness and became firmly affixed there without any conscious effort on his part. The first "whale" of course was the designers, engineers and workers who built the aircraft. The second "whale" was the pilots who flew them, and the third and

no less important component, of which Oleg was now firmly convinced, were the aviation engineer service specialist personnel, without whom successful flight operations are inconceivable. Although they are not all-determining, a great deal does depend on them. Pilots and technicians make up a single combat family. The main thing is their unity and complete mutual understanding.

Oleg enrolled at the Riga Higher Military Aviation Engineering School imeni Ya. Alksnis, the same one from which his father had graduated. The five years of study passed swiftly. Oleg Nikiforov graduated as a mechanical engineer specializing in aircraft powerplants, acquired diversified engineering knowledge, and received a commission. Thus began a difficult but interesting and fascinating career in the Air Forces.

Sr Lt O. Nikiforov is presently a section technical maintenance unit chief and serves as Komsomol organization deputy secretary. Three of the five helicopter crews in his section display an Excellent-Rated Helicopter marking on their helicopter. Oleg is one of those people who are capable of developing to their fullest potential in what would seem to be a routine, uncomplicated job.

Once he and Sr Lt Aleksandr Suchkov, chief of one of the maintenance groups, put their heads together to figure out how to correct a problem in the fuel system at a difficult-access location. They decided not to remove the engine (this operation would take many hours) but to disassemble the vent valve unit. They went right to work on it. It is true that they had to get to the unit via a very small inspection cover, which was very inconvenient. And the cold made things worse. But they followed through on their idea and completed the job.

This incident was not forgotten. Soon Suchkov was transferred to another unit, but he has not forgotten his friend: he visits his old unit whenever there is an opportunity. He is a good friend and a knowledgeable specialist.

* * *

There is another memorable page in his biography -- his tour of duty with the limited Soviet forces in Afghanistan. Oleg recalls the haze over Kabul. In the distance it had the appearance of a mirage city in the middle of a desert. Hot winds would blow clouds of heated dust. His duties included not only flying as a crew member but also hauling urgently-needed supplies and evacuating wounded. Reliable comrades in arms were at his side; that makes everything easier and much simpler.

After combat sorties one sought to relieve the psychological stress. Once the airmen planted saplings.

"Do you really think they'll survive?" asked St Lt Aleksandr Smagin.

"Water them often and they will do just fine," advised flight mechanic Valeriy Belokopytov. "My job is to bring birch saplings from the valley, and your job

is to make them grow. Deal?" He eagerly extended his hand and smiled cheerfully.

Oleg's new friends, just like him, were young, healthy, and fun-loving. They were united by internationalist duty to the people of the friendly country of Afghanistan.

The helicopter crews did not remain long on the mountain plateau. They received orders to move operations elsewhere. Thus these friends do not know whether the white-trunked birch saplings they planted were able to take hold.

...The helicopter crew was readying for a combat mission when word came in that up in the mountains two soldiers had stepped on a mine while approaching a kishlak [village]. They were gravely wounded. They had to be rescued, but how? It was risky to put down on that terrain: the helicopter might be unable to take off. Volunteers, and the most highly skilled volunteers, were needed. The squadron commander briefed his men on the situation and asked for volunteers.

Oleg Nikiforov and the pilot looked at each other. The ground crew could give assurances that the helicopter was in good working order and would not let them down. The aircraft commander knew his men well and trusted them. Their eyes told him that they were ready to go. He had no doubts about his own ability.

The helicopter arrived at its destination. The mountain village was located at the edge of a cliff, and the little village street was so narrow that the helicopter could not put down.

"We can't land here," the pilot uttered in disappointment. "We must look for a suitable site."

They soon found a solution: they could put down between a kilometer and a kilometer and a half from the village, on the road leading to the pass.

When the Mi-24's wheels touched down, the pilot decided to ease it on over toward the village. They reached the first buildings, tall huts on the right and left. Suddenly they heard a metallic cracking sound. What was happening? Just to be safe, the pilot throttled down and came to a stop....

There was no time to inspect the aircraft: at any moment bandits could jump out from behind the huts and open fire. It took several minutes to load the wounded. A critical moment was at hand -- takeoff. The engines roared at full throttle. Seconds seemed like hours. Finally the helicopter, slightly rocking, began slowly rising from the dry, sun-baked ground. When the helicopter had safely returned to its base and the main rotor blades came to a stop, the crew chief [flight technician] exclaimed in amazement: "Two access covers have torn off. How were we able to get it into the air?"

"We managed!" the pilot replied.

* * *

Return to familiar surroundings. Around him were his friends and colleagues: section technical maintenance unit chiefs Sr Lt Nikolay Ozerov and Aleksandr Baykov, and Aleksandr Ivanov, the squadron's top crew chief.... He soon once again became engrossed in the normal work routine, as his Afghan impressions gradually faded into the background.

When I met this officer, his outfit was getting ready for a 6 month end-of-training-period performance evaluation.

"We're supposed to have a meeting today, but it had to be postponed due to flight operations," said Oleg.

"Am I here at a bad time?"

"Not at all," he smiled. "If the meeting were held, I would have to leave you in..." -- he glanced at his watch -- "...15 minutes. But this way we have a chance to talk."

"A 6-month performance evaluation?" I asked. "What about the year's performance?"

"Our outfit received a mark of good for last year," Senior Lieutenant Nikiforov replied, as if stating the obvious. "Here are my thoughts," the officer continued. "Why is it that things are going well for us? There should be order in all things, as my father says. Order, responsibility, and discipline. In the military a great deal is determined by the level of organization. Everything begins with the schedule. A well-conceived schedule is half the job. We put out considerable effort to avoid departing from the schedule. Major Malankov keeps a close eye on ensuring that ground maintenance personnel adhere to the schedule. He is always ready and willing to give advice and assistance where needed. And our commanding officer, Major Davydov, is always checking what has been accomplished and how. If he discovers any deficiencies due to anybody's fault, that person will be made to answer."

* * *

High school, service school, the busy routine of military service, and combat experience obtained in Afghanistan -- all this has required considerable moral and physical energy. Senior Lieutenant Nikiforov has become convinced through practical experience of the correctness of a simple axiomatic truth: a sound mind in a sound body. He inherited from his father the habit of engaging in gymnastics on a daily basis.

"This is a tough workout!" one of the airmen, working on the horizontal bar, exclaimed with feigned displeasure.

"It's Nikiforov's workout," his buddies replied. "Don't wimp out; you can do it."

In the meantime Oleg Nikiforov was appearing before the municipal swimming pool's coaches board. The senior lieutenant was being congratulated on successfully passing the test to earn the title of swimming instructor. Now he can finally organize a swimming group in the squadron.

Sr Lt N. Ozerov was the first person the beaming Oleg encountered.

"What are you smiling about?" Nikolay inquired.

Learning the reason, he offered congratulations and immediately asked to join the swimming group. Ozerov was followed by Sr Lt Anatoliy Yegorov, WO Sergey Makaseyev, and other airmen.

Oleg Nikiforov has another interest, about which few are aware. Upon entering his apartment one immediately realizes that he has a love of ships. Models of old sailing vessels -- Spanish galleasses, Greek galleys, and English brigs -- adorn the room. Each vessel is precisely to scale and built with great skill and care. Oleg did not waste those many hours spent in Riga's Library of Historical Books, reading and studying the appropriate literature. Most of the books are in English, which Oleg has mastered.

Oleg gains a great deal from this hobby: it stimulates his technical thinking, without which today's engineer cannot work to the full extent of his ability.

...Things were quiet in the apartment on Gastello Street. Everybody was asleep. Only the kitchen window would remain lit far into the night. Oleg Nikiforov is preparing to enroll in military postgraduate study.

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UNMANNED PROBES STUDY MARS AND ITS MOONS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 42-43

[Article, published under the heading "Responding to Readers' Questions," by V. Balebanov, deputy director of the USSR Academy of Sciences Institute of Space Research: "Project 'Phobos'"; first part of a multipart article]

> [Text] Today Soviet scientists are drawing up new, magnificent plans for exploration of the Solar System, including a mission by space vehicles into the asteroid belt with a landing on one of the asteroids, and combined investigation of Mars and its moons, Phobos and Deimos. Following tradition, the USSR Academy of Sciences has invited scientific organizations in a number of other countries to take part in the project. Scientists in Bulgaria, Hungary, the GDR, Poland, Czechoslovakia, Austria, the FRG, Finland, France, Sweden, Switzerland, and the European Space Agency have responded enthusiastically to this invitation. The new joint investigations will promote not only greater knowledge of the Solar System but also further strengthening of mutual understanding and cooperation among peoples.
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> In response to numerous reader requests, we present the following article by V. Balebanov, deputy director of the USSR Academy of Sciences Institute of Space Research, on the tasks and itinerary of Project Phobos.

Mars, an outer planet in relation to the Earth, is the most convenient planet for astronomical investigations. Every 780 days it approaches to a distance of 55-102 million kilometers from Earth. During these periods the conditions of illumination of Mars are more favorable for photography. At its closest approach -- opposition -- light travels from Mars to Earth in 3 minutes.

In the telescope Mars appears as a small diffuse orange disk, on which one can see details of three types: elongaged regions (they were long called deserts), a dark equatorial belt, and white polar caps. As a rule the surface is clearly visible through the planet's highly rarefied atmosphere. Sometimes one observes light clouds -- white, light-blue, and yellow (dust clouds).

With the telescope one can distinguish only large features at least 300-600 km in size, since Mars is so distant from us.

A new stage in the study of this planet commenced with the beginning of the space age. It is true that even today, 30 years after the launching of the first artificial Earth satellite, plans for interplanetary manned missions are only at the initial stage. And the cost of such missions is still too great even for highly-developed countries. The first manned mission to the Moon, as part of the Apollo program, cost 25 billion dollars. The Pioneer mission (launching of unmanned probes toward Jupiter, located much further from Earth than Mars) was cheaper by a factor of 250. The information about Jupiter obtained by these probes proved to be quite considerable. An ordinary suburban outing and a long around-the-world voyage -- one can make this approximate comparison in nature and complexity for manned missions to the Moon and unmanned missions to the planets.

Unmanned probes are destined to blaze the trail for man to the other planets. Mars was the second planet to be reached by man-made orbital vehicles. This took place at the end of 1971, when the U.S. Mariner 9 vehicle and the Soviet Mars 2 and Mars 3 probes went into orbit around Mars. Mars 3 was operating during an exceptionally violent dust storm on that planet, which obscured its entire surface. It has long since been noted that dust storms occur during opposition. But a storm of such intensity had never before been observed.

One of the most interesting phenomena connected with a dust storm is the so-called reverse greenhouse effect. Hundreds of millions of tons of dust rise into the Martian atmosphere, dust which is opaque to incoming and transparent to outgoing radiation, which causes cooling of the planet's surface. On the other hand, the atmosphere heats up rapidly.

Detailed acquaintance with the Martian surface did not begin until 1972, when the dust storm ended, which made it possible to proceed with photographing the planet. Subsequently, in 1974, the Soviet Mars 4 and Mars 5 probes took very high-resolution photographs of regions which had been poorly visible through residual obscuring dust. It was ascertained that the topography varies from one part of the planet to another. The most typical regions are vast cratered areas, desert plains, volcanic zones and, finally, regions of a particular topography which do not fit within any one group.

Analysis of photographs transmitted back from the probes failed to reveal any of the much-talked about canals. Just what had the terrestrial observers been seeing? Some scientists believe that the Martian "canals" are tectonic valleys developing along deep faults. The longest of these features is 5,000 meters, comparable to large terrestrial linear fault zones. Others believe that the "Martian canal effect" is nothing other than perception of a number of poorly-distinguishable dots or spots located along a single line. Processing of photographs indicated in particular a good agreement between lines of "canals," clusters of craters and tectonic fracture zones. Points of "canal" intersection, so-called oases, coincide with areas of maximum density of craters or fractures.

At the present time some natural Martian topographic features are called canals, such as, for example, a system of narrow, parallel fissures. They stretch in a line extending up to 1,800 kilometers in length. They are up to several hundred meters in depth and a kilometer or less across.

Investigators have focused particular attention on features reminiscent of terrestrial river valleys, for rivers and water mean possible life, if not today then at some time in the past. Typical gulleys or ravines are observed in addition to features similar to river valleys. The latter are as large as some of the Martian "fluvial valleys" and are much larger than counterpart terrestrial gulches. In spite of the similarity between Martian and terrestrial valleys, they also display a number of differences. For example, while they are commensurate in length with terrestrial rivers, they are considerably wider. They have apparently formed without the influence of tectonics. This is indicated by the absence of terraces. The Martian rivers are also less meandering, and their islands are more elongated.

In 1973 Soviet probes performed the first direct investigations of the Martian atmosphere. Atmospheric pressure averaged 1/200th of the Earth's atmospheric pressure. We say averaged because pressure may reach 10 mbar in lowland areas and less than 1 mbar on some mountain peaks. It was established that the Martian atmosphere consists primarily of carbon dioxide -- 95 percent. It contains a negligible amount of oxygen, water vapor, carbon monoxide, and ozone. Mars 6 also detected the inert gas argon.

The composition of the polar caps was long the subject of scientific debate. Their white color suggested that they are formed of ice. It was known that the size of the polar caps changes periodically: they grow larger in winter and shrink in summer. The explanation was given that the ice melts with the onset of spring, releasing water. In 1979, however, scientific probes transmitted information, analysis of which indicated that the polar caps consist not of water ice but of dry ice -- frozen carbon dioxide. The temperature of the material of the polar caps proved to be very low: -125 degrees C, a temperature at which carbon dioxide condenses. Later, however, it was determined that the polar caps do in fact contain a small quantity of ordinary water ice.

Gradually, as more detail was learned on the composition of the atmosphere, the enormous role played by the polar caps in the physics of the Martian atmosphere became evident. In contrast to Earth, where the forming of weather processes is determined primarily by the interaction between the atmosphere and the ocean, on Mars the seasonal exchange between the atmosphere, polar caps and the soil is of major importance. Water vapor should also play a significant role in this exchange. Water content in the Martian atmosphere is smaller on the average by a factor of 1,000 than in Earth's atmosphere, and even smaller in the polar regions, by a factor of 10 at the very least. At the same time measurements taken by the Mars 3 and Mars 5 probes indicated that in some areas water content may be appreciable.

In the fall, when the temperature drops, water vapor freezes out of the Martian atmosphere, forming a persisting snow cover, consisting of water ice. This cover extends southward and is deposited onto the surface of an oceanic

plain, onto sand features and craters, but does not fully cover them over due to its negligible thickness. In winter, when the temperature drops further, initially a hydrate gas forms, which breaks down with a further temperature drop into solid carbon dioxide and water. Heat of phase transition is released, and the temperature stabilizes at -125 degrees C. This is the lowest possible temperature on the Martian surface.

In the spring, when the polar cap melts, enormous quantities of carbon dioxide gas are released, which are ejected into the atmosphere and raise atmospheric pressure above the polar cap. Extremely strong winds form, reaching velocities of 40-70 and sometimes more than 100 meters per second. They carry large quantities of gas into the autumn hemisphere, where they condense.

The winds are probably accompanied by powerful whirlwinds, which raise tiny particles from the surface of the unconsolidated soil. As the wind picks up, the quantity of dust raised into the atmosphere can become quite substantial. At this point the reverse greenhouse effect begins to operate: dust clouds intercept a large part of the solar energy, and the Martian surface cools. Large local temperature drops occur, which causes the winds to pick up to an even greater velocity.

Unmanned interplanetary probes experimentally established the absence of a fairly strong Martian magnetic field which could shield the planet's surface from bombardment by charged particles. The very rarefied atmosphere, consisting almost entirely of carbon dioxide, the low temperatures, and the absence of a magnetic field -- all these factors have unquestionably greatly undermined the arguments of the advocates of an inhabited Mars. The question of life on this planet, however, still remains open. Even the U.S. Viking landers, in spite of the comprehensive nature of the experiments they performed, were unable to furnish an unequivocal answer.

After landing on the Martian surface, these vehicles investigated solid samples taken from depths of from 4 to 6 centimeters. Instruments recorded the release of comparatively large amounts of oxygen, water vapor, and carbon dioxide. No traces of organic compounds were detected, however.

But is there life on Mars? Considering everything which scientists today know about this planet, one can state that, even lacking proof of the existence of life on Mars, one is hard put to find and substantiate reasons why life could not exist.

As for the Martian moons, the great English satirist Jonathan Swift was the first to mention them, in 1726, in his famous "Gulliver's Travels." It was not until one and a half centuries later that the Martian moons were discovered by American astronomer A. Hall. Their orbits differed little from those predicted by Swift.

These moons were given the names Phobos and Deimos (Fear and Terror). The sidereal period of Phobos is 7 hours 30 minutes, while that of Deimos is 30 hours 18 minutes. It is interesting to note that the orbits of Phobos and Deimos are lower and higher respectively than a stationary orbit, in which the

angular velocity of a moon's revolution coincides with the angular velocity of rotation by Mars on its own axis.

Due to the moons' small size, terrestrial observers were unable to determine their mass and size in a relatively accurate manner. Assuming that their reflectivity is the same as that of Mars, attempts were made to estimate the size of the moons from their luminosity. Their mass was determined in the same manner, by multiplying the obtained volume by the average density of typical terrestrial rocks. Measurements performed by unmanned probes indicated that the size of Phobos and Deimos is almost twice that which had been conjectured. Thus the Martian moons proved to be considerably smaller in relation to Mars than the Moon is in relation to Earth. Just as the Moon, hwoever, Phobos and Deimos always face Mars with the same side -- their major axis is always pointed toward the center of the planet.

When more detailed photographs were taken of Phobos by unmanned probes, quite unexpected features were discovered -- a great many straight and approximately parallel furrows 200-300 meters in width and 20-30 meters deep. Almost all begin at the large crater Stickney, which is 10 kilometers in diameter, more than one third of the diameter of the moon itself. Apparently a powerful impact during collision with a large meteorite not only formed the crater but also cracked the entire surface of Phobos.

The mass of Phobos proved to be less than expected by a factor of 1.5, which corresponds to an average density of only 2 g/cm cubed. Consequently it cannot consist of dense rocks melted by volcanic processes, which form the crust and mantle of the terrestrial planets. Spectral observations of changes in the reflectivity of this Martian moon indicated that they are of the same character as that of meteors. In addition, a low rock density is characteristic of bodies of this composition.

Deimos, judging from the reflective properties of its surface, consists of the same material as Phobos. Its topography is different, however: its surface is not furrowed, nor is there a single large crater; its many small craters and blocks are entirely or partly covered by a layer of regolith (surface layer) several tens of meters thick.

The irregular shape of the Martian moons suggests that they are typical asteroids "captured" by Mars in ancient times. We should note that the neighboring asteroid belt played an important role in forming the planet's relief.

As a consequence of their small mass, Phobos and Deimos should not have undergone substantial geologic changes from the moment of formation of the Solar System approximately 4.5 billion years ago, and apparently have been preserved in a close to original state. The regolith, under the effect of the solar wind and bombardment by meteorites, undoubtedly has been somewhat reworked. Therefore study of the soil of the Martian moons will make it possible to judge not only the conditions of formation of bodies in the Solar System but also their subsequent evolution.

Investigations of Mars and its moons are of extraordinary interest to science. Answers to the many questions which scientists plan to "ask" them will help us gain better knowledge of the fundamental nature of the Earth and come closer to an understanding of the factors which caused its uniqueness and led to the emergence and rapid evolution of life only on one of the planets. (To be continued)

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HISTORY OF SOVIET SPACE PROGRAM TELEMETRY FLEET

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 44-45

[Article, published under the heading "Space Flight Support," by B. Pokrovskiy, scientific staff member, space command, control and telemetry complex: "'Star' Fleet"]

[Text] On one of its first voyages, the "Kosmonavt Vladimir Komarov," performing a support role for the Zond 5 mission, happened to be positioned off the coast of North America. U.S. newspapers ran sensational headlines: "New Russian Secret Weapon," and "Soviet Space Ship 'Kosmonavt Vladimir Komarov' Approaches U.S. Shores." The articles were accompanied by photographs of the ship, on the deck of which rose huge white spheres several stories tall. Commentators, outdoing one another in their fanciful conjectures, formulated wild guesses about what kind of new Russian weapon this was. The storm raised on shore also troubled the calm ocean surface. U.S. submarines surfaced practically right out from under the ship's keel. Destroyers steamed right up to it, and helicopters hovered noisily above the deck.

When the Soviet ship docked in Montevideo, the crew received on board members of the Uruguayan, U.S., British, French, and West German press and held a press conference. The journalists learned that the ship was indeed a "space" ship -- the U.S. newspapers had not been wrong in this, but the function of the huge spheres was merely to protect the telemetry antennas against weather.

What are the functions and history of the "star" fleet? This is the subject of the following article.

On 21 August 1957 a ballistic missile, traveling more than 6,000 kilometers, delivered its nose cone "to the country's very edge." But how could more powerful rockets be tested? After all, their flight would end beyond the borders of our homeland, in the waters of the Pacific. At that time one of our scientific research institutes was instructed to devise methods and means

of monitoring the overwater segment of flight and of determining the coordinates and time of missile splashdown. This scientific research topic was given the name "Akvatoriya" [Waters]. It was an important, priority project. The institute's deputy director was placed in charge of it.

"The project should result not only in scientific reports," he stated at the first meeting of project personnel and scientists of many areas of specialization, "but also in ships carrying telemetry monitoring and communications equipment deployed in the Pacific Ocean. And not at some indeterminate time in the future but in October 1959. Sergey Pavlovich Korolev has designated this time frame for testing a new booster...."

Development of telemetry methods using the technical means available at that time was advancing comparatively rapidly: "dry-land" experience was an assisting factor. But things were more difficult as regards ships. The USSR Ministry of Maritime Fleet needed every vessel it had, and a decision at a higher level was required to turn over even a single ship for other needs. The institute director and the "Akvatoriya" project manager, energetic and persistent individuals, as well as other people of initiative on the project, succeeded in persuading officials at all echelons of authority of the need to assign them ships.

Work proceeded at full pace as soon as the allocated ships arrived at the shipyard docks in Leningrad. The designers made a bold and perhaps the only correct decision under the circumstances: to strip general cargo ships down to the bare hull, machinery and steering gear, and refit from there.

People made every effort to accomplish this unusual work order on schedule. They worked day and night. To save time, the decision was made to use aircraft to test the electronics. The tests were successful.

Another important matter had to be settled: by what route should this unique fleet be sent to its permanent deployment area -- the Pacific Ocean? There were three possibilities: one route stretching more than 23,000 kilometers, via the Suez Canal; a second route, 29,400 kilometers, around Africa; and a third route -- less than half the length of the second, but much more difficult -- the Arctic Ship Route. After weighing all the pros and cons, they chose this route. As they say, in one's own house even the walls help.

On the designated day and at the designated hour, the fleet steamed out of the Neva, swung around Scandinavia, Europe's largest peninsula, and arrived at Murmansk ahead of schedule. Following a brief stay in port, during which the ships replenished supplies and specialist personnel were added to the crews, this unique fleet proceeded on its way. It was led by veteran mariner Yu. Maksyuta, who was later awarded the Lenin Prize.

Icebreakers led the way along the most difficult route segments, while out ahead Arctic veterans, including famed Arctic explorer Ye. Tolstikov, conducted ice reconnaissance by aircraft. In spite of the difficulties, passage was accomplished in record time for those years -- less than a month!

Nor did the specialist personnel on board waste time en route. They honed their skills in operating the equipment and worked on coordination and communications between ships. They were greatly assisted by the operation and maintenance documentation and the manuals of personnel procedures prepared at the initiative and with the participation of A. Bachurin, head of the field unit on the ship "Sibir." Today he is on the staff of USSR Glavkosmos, a candidate of technical sciences, a recipient of a USSR State Prize, and a member of the Bureau of the USSR Federation of Cosmonautics. Other field units also used this documentation, which prescribed interchangeability among the specialist personnel of telemetry station teams.

The fleet's first work assignment, in October 1959, was successfully accomplished in spite of heavy weather and was given high marks by the state commission and the technical supervisor, as Sergey Pavlovich Korolev's position was called in documents at the time.

At that time the space program, which was taking its first steps, also required expanded operations by the space command, control and telemetry system. The fact is that on-land telemetry stations, no matter how many are established on our country's territory, are unable to provide around-the-clock communications with space vehicles. Calculations indicated, for example, that for a satellite with an orbital period of about one and a half hours, at least six of its 15-16 daily revolutions are out of radio contact from Soviet soil. In addition, the need for telemetry facilities beyond our country's borders was also dictated by the fact that the first unmanned interplanetary probe, the Venera 1, was soon to be launched. But monitoring of its boost from orbit was possible only from the waters of the Atlantic. It was not feasible to shuttle ships back and forth from one ocean to another. In addition, calculations indicated that ships were needed simultaneously both in the Pacific and Atlantic.

Experience in developing ships for ballistic missile testing helped accomplish faster refitting of the general cargo ships "Ilichevsk," "Krasnodar," and "Dolinsk" for the space program. In August 1960 they made their first voyage to prepare for performing a support role in the Venera 1 unmanned interplanetary probe mission. In February 1961 the specialists manning the shipboard telemetry stations, together with their land-station colleagues and the newly in-service Long-Range Space Communications Center -- accomplished flawless control of the first interplanetary flight. Subsequently they also made a substantial contribution to the manned space program.

In 1965-1966 the veteran ships "Ilichevsk" and "Krasnodar" were replaced by more sophisticated vessels -- the "Bezhitsa" and "Ristna," equipped with high-powered electronics. The research vessel "Kosmonavt Vladimir Komarov" became the first of a new generation of shipboard command, control and telemetry stations. The white spheres on its deck (two very large sphere plus a smaller one) are sheltering structures which are transparent to radio-frequency emissions, constructed of a special, high-strength material. They protect the antennas from heavy wind loads, precipitation, and the high humidity of the marine environment. The vessel is packed with scientific gear. It made its maiden voyage in August 1967.

Three years later the fleet was joined by an even more sophisticated scientific vessel -- the "Akademik Sergey Korolev." The fleet's flagship -- the "Kosmonavt Yuriy Gagarin" -- which is still one of a kind, was the state of the art of space-program naval architecture. Judge for yourself: length 231.6 meters, beam 31 meters, and displacement 45,000 tons. This ship is equipped with general-purpose and specialized computers, control-telemetry and antenna systems (weight 180 and 240 tons, antenna dish diameter 12 and 25 meters respectively), providing capability to conduct with any space vehicle the entire scope of work activities handled by the most up-to-date land command, control and telemetry facility. The ship even carries its own facility to produce liquid helium for cooling the receivers' parametric amplifiers.

The national flag of the USSR was raised on board the "Kosmonavt Yuriy Gagarin on 14 July 1971.

Between 1975 and 1977 "star" fleet veterans, the general cargo ships "Dolinsk," "Ristna," and "Bezhitsa," took off their space armor and returned to the merchant fleet. Between 1977 and 1979 they were replaced by the most up-to-date telemetry liners, the snow-white sides of which carry the names of cosmonauts P. Belyayev, V. Volkov, G. Dobrovolskiy, and V. Patsayev. These ships handle two-way communications with spacecraft crews, receive vast streams of spacecraft telemetry data, process and transmit this data to the appropriate centers -- mission control and coordination-computer centers. The level of automation and computerization of equipment control is considerably higher on these ships than on all earlier vessels. The designers also concerned themselves with providing good conditions for work, leisure and rest for vessel crew and technical staff members.

The "Kosmonavt Vladimir Komarov" recently returned from many months at sea. For many years this ship has sailed the seas and oceans under the guidance of experienced master mariner captain V. Kononov, a combat veteran of the Great Patriotic War. In the most difficult and hazardous situations, which frequently occur during heavy weather, he performs with decisiveness and skill, showing younger crew members an example of courage, expertise, and a strong sense of responsibility.

"It is in large measure thanks to our captain," stated A. Chernikov, who heads the ship's scientific and technical staff, also no newcomer to the sea (he has been working with a field unit for more than 15 years now), "that the crew and scientific staff live and work together amicably. Our test personnel also did a fine job on this most recent voyage. Our ship took part in providing support for many complex dynamic operations in space -- launch of the new-generation Mir space station into orbit, and docking of the Soyuz T-15 spacecraft, manned by Kizim and Solovyev, as well as supply spacecraft."

By the time you readers receive this issue, the "Kosmonavt Vladimir Komarov" will be far from our native shores. The ship has logged to date more than half a million nautical miles at sea. Over a span of two decades it has sailed the equivalent of about 25 times around the world at the equator. Keeping pace with it are the other ships of the "star" fleet, working together with land command, control and telemetry facilities to carry out the tasks

assigned by the 27th CPSU Congress pertaining to further study and exploration of space in the interests of our country's science, economy, and culture as well as worldwide progress and peace.

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FLAWS IN SPACE SHUTTLE PROGRAM REVEALED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 9, Sep 86 (signed to press 1 Aug 86) pp 46-47

[Article, published under the heading "Abroad," by Ye. Yermakov: "Space Race"; first part of a two-part article; based on materials published in the foreign press]

[Text] Up to a few years ago the United States and the majority of foreign countries engaged in space research were launching many satellites into orbit with the U.S. Delta booster. Western observers had even dubbed it a "workhorse." Today this rocket is no longer a viable booster, and the U.S. has virtually retired it from production. Today the U.S. Space Shuttle and the West European Ariane booster are considered equals as the principal "workhorses" of the space program abroad. The contest between them is reminiscent of a steeplechase race in connection with the alternating failures in putting satellites into orbit with the Space Shuttle or Ariane. Each time one of these "space horses" fails in its attempt to negotiate one of the steeplechase obstacles, the other takes the lead.

At the same time the contest between the Ariane and the Space Shuttle is akin to the battle between David and Goliath -- their specifications and performance figures are so disparate. The launch weight of the Space Shuttle is 10 times that of the Ariane, exceeding 2,000 tons. The payload which the Space Shuttle can put into a low circular orbit runs almost 30 tons, which is 6.5 times the payload boosted into low orbit by the first version of the Ariane. Packed with state-of-the-art equipment manufactured according to the latest technology, as well as being reusable, the Space Shuttle is unquestionably a major achievement of space technology. Its competition is a one-shot rocket which is less powerful than such boosters as the Atlas-Centaur and the Titan 34D.

In any case, prior to commencement of this unique space race the Space Shuttle was considered the definite favorite, although it was quite slow in leaving the starting line. It is precisely this latter circumstance which explains the partial success of the Ariane rocket at the beginning of the 1980's. With the passage of time, however, it became increasingly clearer that the Ariane booster, developed by a consortium of West European countries, was fully capable of competing with the Space Shuttle. Last year the then director of

the U.S. National Aeronautics and Space Administration (NASA), J. Biggs, was forced to acknowledge this fact, noting loss of the Space Shuttle's dominant position in the world market as a means of putting satellites into orbit. This admission was made almost a year prior to the explosion of the "Challenger," which damaged the Space Shuttle's position to an even greater degree and caused the Ariane to surge ahead.

But how is it that an "old model" (as Von Braun called it) West European booster has proven capable of competing with the Space Shuttle even in launching U.S. satellites? After all, when NASA first proposed the Space Shuttle project, the figures put forth were considered fantasy: as many as 100 orbital missions, and total recouping of development costs over a period of 10-12 years of operation, with a cost of putting a satellite into orbit which would be one tenth the cost using an expendable booster.

It has indeed proven to be a fairy tale, totally at variance with reality and requiring, as was later ascertained, that the Shuttle project be approved with a sharp decline in public interest in the U.S. space program at the beginning of the 1970's. In actual fact the Space Shuttle has proven to be an extremely costly, an unprofitable and, most important, a dangerous means of boosting a satellite into orbit (the fact is that a manned mission is required for each satellite launch).

Let us first talk about profitability. The U.S. firms Rand Corporation and Mathematics conducted studies prior to approval of the Space Shuttle, which indicated that the program would begin to turn a profit if as many as 36 Shuttle missions were flown annually. These estimates, however, were based on highly overstated figures characteristic of a project in its initial stages: a fully-reusable system at a total cost of 5.5 billion dollars. What was actually produced, however, was a version with an expendable external fuel tank, with partial replacement of solid-propellant boosters, and a partially reusable orbital stage (with loss of part of the heat shielding and periodic engine replacement). One magazine estimates that the cost of the Shuttle program totaled 20 billion dollars in 1983 (in 1983 dollars): 10.083 billion dollars for development and 9.268 billion dollars to build four Shuttle craft — "Columbia," "Challenger," "Discovery," and "Atlantis" (to date "Columbia" has flown seven missions, "Discovery" has flown six, "Atlantis" has flown two, while "Challenger" blew up during its 10th launch).

In other words the number of annual "profitable" Shuttle missions should be increased severalfold, which is no easy task, especially if one considers the operational cost of each mission (including the cost of manufacture of the external tank and other Shuttle craft components which are expended during launch) and the cost of aftermission repair and overhaul requirements. The operational cost of a Space Shuttle launch is not really different from that of launching expendable rockets. According to current estimates, it exceeds 100 million dollars for the Space Shuttle, but in the future it will increase as a consequence of inflation. The cost of aftermission repair and refurbishing, performed by private companies, is not "charged" to a specific Shuttle craft. The solid-propellant boosters are not fully reusable; only certain components, following overhaul, are shipped to the factory and are used in part in assembling solid-propellant boosters for future Shuttle

missions (virtually new solid-propellant boosters, assembled from parts of various previously-used boosters, are provided for each mission). The most realistic projections as of last year stated the possibility of increasing the number of missions annually to 25-30 by 1992. But the January 1986 tragedy at Cape Canaveral has pushed this date further into the future. In addition, an increase in annual Shuttle missions is being held back by inadequate mission loading of the four-ship Shuttle fleet, and a significant role in this has been played by successful competition with the Space Shuttle by the Ariane rocket.

In any case, few Americans are talk ing about profitability of the Space Shuttle program, since many are concerned about how to reduce the enormous expenditures on correcting problems with the Space Shuttle systems and on repair and refurbishing operations. After six missions flown by the first Shuttle, "Columbia," for example, a major overhaul was required, costing about 300 million dollars. In view of the operating cost of each flight and postmission repair and refurbishing, as well as other expenditures (the solid-propellant boosters were not reused once, and the main engines were replaced after the fourth flight), it turned out that this Shuttle craft had become more than a billion dollars more expensive.

In connection with these additional outlays on "Columbia," it was hastily declared to be the most expensive Shuttle craft. Less than 10 days after "Columbia"'s seventh mission, however, the second Shuttle craft, "Challenger," met with disaster as it was lifting off on its 10th mission. This resulted in an even greater cost to NASA, since the loss of this craft will require building a new Shuttle craft. Last year the cost of building it was estimated at 2.2 billion dollars, but if one includes preceding expenditures on "Challenger" (the operational cost of its missions, the cost of repair and refurbishing activities, etc), it turns out that additional expenditures on the second U.S. Shuttle craft total about 4 billion dollars.

This estimate is determined in large measure by the operational cost of a Shuttle mission, which has proven to be quite substantial. Last year, seeking to justify its pricing policy for putting satellites into orbit with the Space Shuttle, NASA proceeded from a Shuttle mission operating cost of 71-87 million dollars. During Congressional hearings, however, officials from the Department of Commerce, Transportation and other agencies testified that the actual cost substantially exceeded 100 million dollars. In other words, just the operational costs of 10 Shuttle missions total in excess of a billion dollars, and if one includes possible expenditures for an emergency "major" overhaul (as was the case with "Columbia"), one must admit that Shuttle flights cost more than one would assume on the basis of NASA estimates.

It is now becoming clear that NASA has always artificially pushed down the price on launching satellites with the Space Shuttle. At first this was done in order to obtain project approval, and subsequently to justify invested funds. In 1979, even prior to the first Shuttle mission, former NASA employee B. O'Leary commented that in his opinion the cost of launching a satellite with the Space Shuttle was in fact greater than the cost using an expendable booster rocket. In 1982 Office of Management and Budget officials warned that NASA was using 1977 prices for satellite launching, while in fact the cost of

launching a satellite with the Space Shuttle was half again as large just considering inflation.

At that time, however, nobody yet imagined what enormous expenditures the Space Shuttle would actually involve, and NASA had recently begun to remain silent about actual expenditures. "Major" overhaul of "Columbia" cost 300 million dollars, for example, just according to unofficial figures, while the actual cost might prove to be much more. Last year the question of increasing charges for launching satellites with the Space Shuttle was raised in Congress, but even NASA officials acknowledged that the new rate for Space Shuttle payload which was to go into effect the following year was somewhat lower than actual cost. The fact is that at the present time NASA is simply afraid of losing customers, since the actual cost of launching a satellite with the Space Shuttle is in fact greater than with an expendable booster (including the Ariane).

Several years ago, for example, U.S. Air Force experts calculated that from all standpoints use of an expendable Titan 34D-Centaur is less costly to the Air Force than to use the Space Shuttle to launch satellites. In connection with this, the military services announced that in the future they intended to use expendable boosters to launch their satellites. As a result it was necessary for the U.S. Government to instruct the Air Force to use one third of each year's Space Shuttle missions, beginning in 1988, for launching satellites and other purposes. In order to understand the difficult situation in which NASA finds itsef, we should note that according to the present contract, the U.S. military services pay for a Space Shuttle mission at a rate which is 33 percent lower than the official NASA rate charged other users (including NASA itself).

And yet there is no call for NASA to be upset at the military services, for if it were not for the Pentagon with its vaunted "Star Wars," the Space Shuttle program would have ended in a major financial fiasco. At the end of the 1970's, when additional appropriations were needed to maintain schedule on the Space Shuttle program, it was decided to reduce to a minimum the NASA scientific programs (many scientific research programs were simply cancelled). In the 1980's all applied programs have been shifted over to the private sector, as well as part of the activities involving servicing Shuttle launches, repair and refurbishing activities. The entire NASA budget was now being spent almost entirely on the Space Shuttle, but this approach proved to be fraught with serious consequences: the cutback of NASA scientific research programs in the final analysis resulted in inadequate work-loading of Shuttle missions.

At this point they recalled that from the very outset the Space Shuttle project had been intended for military purposes as well as for servicing a permanent orbital station. The station project, however, failed to win support at that time and was placed in limbo for an entire decade. Concerned by this fact, and also foreseeing difficulties with task-loading Shuttle missions in the future, F. Moss, chairman of the Senate Aerospace Subcommittee, in January 1975 even raised the question of the possible use of

U.S. Shuttle craft to service Soviet Salyut stations. This proposal received no support, and F. Moss failed in his Senate reelection bid.

After 10 years the permanent orbital station project was revived, but by this time the entire U.S. space program had undergone considerable changes, which also affected the orbital station project. The fact is that at the beginning of the 1980's it was decided to place the Space Shuttle program under the control of the Pentagon, covering its development costs by this means. And although from the very outset the Space Shuttle project was intended to perform military missions as well and a substantial percentage of total missions was reserved for the Pentagon, from this moment on the entire Space Shuttle program began to be viewed as an important element in escalation of the arms race in space.

Since 1982 the U.S. Department of Defense's annual space budget has exceeded NASA's total annual budget. Three high-ranking generals from the military services were appointed to top NASA positions in turn, and soon a large percentage of the NASA budget also began to be allocated for research in the area of using the Space Shuttle for military purposes. In 1983 total combined NASA and Pentagon expenditures on space-related projects exceeded 15 billion dollars, and naturally such a rate of growth more than covered the entire financial mess of the Space Shuttle program. NASA began to pay less attention to the problems of the Space Shuttle and sometimes even ignored them, which in the opinion of many experts was one of the factors in the tragedy at Cape Canaveral.

The explosion of "Challenger" and the death of seven U.S. astronauts laid bare all the shortcomings of the U.S. Space Shuttle connected with flaws in its design. Initially insufficient funding and subsequently unwarranted acceleration of the program by the Pentagon led to a situation where the designers of the Space Shuttle simplified a number of design solutions, sometimes contrary to the requirements of Shuttle craft reliability and flight safety. This began at the very beginning of the Space Shuttle program and, in particular, led to the choice of solid-propellant boosters. The idea was that separated boosters descending by parachute and retrieved would be able to be used as many as 20 times on subsequent flights. Experience has shown, however, that they can only be used in part, in the manufacture of new boosters.

Solid-propellant engines had never before been used to launch manned spacecraft, and therefore the choice of a solid-propellant booster gave rise to certain doubts. Back in the spring of 1973, for example, 13 years before the "Challenger" tragedy, (A. Klever) of the British firm Rolls Royce commented in a discussion with R. Thompson, head of the Space Shuttle program, that the Space Shuttle in its current version would have no advantages over expendable boosters and that using solid-propellant boosters which had been dropped into the ocean and subsequently retrieved could result in the forming of cracks and corrosion, in connection with which subsequent reuse of the boosters would be dangerous.

Saving money to the detriment of reliability also extended to ground facilities, in particular choice of a site for the Shuttle craft launch

facility. From the very outset NASA insisted on Cape Canaveral in Florida as the principal location for the Shuttle craft launch facility. It was obvious to everybody that it was much cheaper to modify the Kennedy launch facility which already existed at this site (this would require only a billion dollars). Also attesting to this is the considerable delay in construction of a second Space Shuttle launch facility (at Vandenberg Air Force Base), which to some degree indicates the greater costs incurred. Of course the true magnitude of these costs is not known, since this space launch facility is intended only for military missions.

In selecting Cape Canaveral for the Space Shuttle launch facility, planners totally ignored the fact that the Space Shuttle's costly heat shielding has a substantial drawback -- it must remain dry during launch. Rain -- and particularly heavy rain -- during launch can lead to fatal consequences in flight. This is the reason one sometimes reads reports in the press that a Shuttle launch has been postponed due to weather. But NASA must have been aware of the opinion of scientists, in particular noted U.S. meteorologist M. Neuburger, that Florida is an area with the most frequent occurrence of thunderstorm activity.

In addition to all else, thunderstorms, as we know, are accompanied by solid cloud cover and strong winds, and sometimes squall lines, which naturally makes it impossible for a Shuttle craft to land, for its orbital stage makes a gliding descent from above the atmosphere and executes a landing approach like an airplane. As a result of this, only five out of 24 Shuttle landings have taken place at Cape Canaveral. As a rule these landings have resulted in brake damage. This is due to the fact that the winds at Cape Canaveral, just as in any coastal area, are usually excessive. (To be continued)

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